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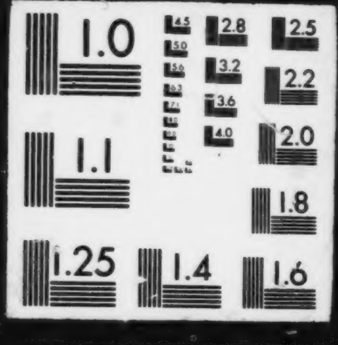
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THE SOCIAL AND ECONOMIC ASPECTS OF WATER RESOURCE QUALITY CONTROL

Edward F. Eldridge

Public Health Service
Portland, Oregon

November 1962

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THE SOCIAL and ECONOMIC ASPECTS of WATER RESOURCE QUALITY CONTROL

Proceedings of the Eleventh Pacific Northwest Symposium on Water Pollution Research

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Portland, Oregon

U.S. DEPARTMENT of HEALTH, EDUCATION, and WELFARE
Public Health Service Region IX

162

PROCEEDINGS

# of the

ELEVENTH PACIFIC NORTHWEST SYMPOSIUM

ON

WATER POLLUTION RESEARCH

THE SOCIAL AND ECONOMIC ASPECTS OF WATER-RESOURCE QUALITY CONTROL

Assembled by

Edward F. Eldridge

Research & Technical Consultation
Project

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE

Public Health Service

Region IX

Portland, Oregon

November 8 and 9, 1962

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FOREWORD

In May of 1957 the Public Health Service established an activity in its Portland office known as the Research and Technical Consultation Project. One objective of this project is to stimulate research in the field of water quality control (water pollution control).

As a means of accomplishing this objective, a series of eleven symposiums has been conducted on the following subjects:

Research on Problems Relating to Water Pollution in the Northwest.

Financing Water Pollution Research Projects.

The Sphaerotilus (Slime) Problem.

Short Term Bioassay.

Siltation -- Its Sources and Effects on Aquatic Environment.

Oceanographic and Related Estuarial Pollution Problems of the Northwest.

Water Problems in Watersheds of the Northwest.

Radioactive Waste Problems of the Northwest.

Research in Water Pollution and Other Environmental Health Fields.

Toxicity in the Aquatic Environment.

The Social and Economic Aspects of Water-Resource Quality Control.

One hundred and thirty-seven persons representing educational institutions, regulatory agencies, State and Federal departments, and industry met in Portland on November 8 and 9, 1962 to discuss the Social and Economic Aspects of Water-Resource Quality Control. Special emphasis was given to the research needs of these aspects of the water pollution problem. This report contains the agenda and proceedings of this meeting.

AGENDA
ELEVENTH RESEARCH SYMPOSIUM

Address of Welcome. Richard F. Poston

Introductory Remarks. Edward F. Eldridge.

The Water Quality Problem -- Policies, Concepts and Research Needs. Leonard B. Dworsky.

Social Factors in Water-Resource Quality-Control Policies and Programs. Roy F. Bessey.

Economic Base Survey: A Tool for Resource Management. Myron Katz.

Discussion. John H. Davidson

Economic Analysis in Water Quality Management. Allen V. Kneese.

Discussion. James A. Crutchfield.

Public Awareness and Information. Marko L. Haggard.

Social and Economic Aspects of The Relation of Land Use to Water Quality. William E. Bullard.

Relationship of Water Quality to Multiple-Purpose Water Resource Development. Donel J. Lane.

Inter-Agency Relationships in Water Resource Development. Roy W. Scheufele.

Comprehensive Planning for Water Quality Control. Reginald C. Price.

Discussion. W. W. Towne.

Summary and Conclusions. Allan Hirsch.

ADDRESS OF WELCOME

Richard F. Poston*

It is a privilege for me to welcome you on behalf of the Public Health Service, Division of Water Supply and Pollution Control, to this -- the 11th in a series of symposia on Water Pollution Research. With the exception of Symposium No. 2 on Financing Water Pollution Research Projects, the symposium discussions have largely dealt with physical matters, for example: the Sphaerotilus problem, radioactive waste problems, toxicity in the aquatic environment, etc.

Today, as evidence of the growing sophistication of water pollution control activities, the subject of this symposium is The Social and Economic Aspects of Water-Resource Quality Control, With Special Emphasis on the Research Needs of the Northwest. This is a timely subject. It covers the area largely controlling the implementation of research results. The physical-phenomenon researcher should be aware of the factors to be discussed here in the next two days, as they may clue him in to a system of priorities for his efforts, or outline the groundwork which must be done to have research results adopted on a plant-size scale. We also need research on the socio-economic problems that are related to the quality aspects of water resource planning.

Nowadays, we need as wide and versatile an attack upon the problem of pollution control as can be brought to bear. In pollution control, we cannot play a detached, ascetic role. We need understanding, mutual trust, and commingling of the genes and chromosomes of individual ideas and efforts. I believe a marriage of Social and Economic Aspects of Water Quality with Research will be blessed with progeny well fitted to cope with the rapidly-emerging water pollution problems of the future.

You have an outstanding group of leaders for your discussions, which, as in the past, are to be informal. I urge that each of you join in the discussions and contribute to the success of this meeting by advancing your concepts, approaches, and questions. This is the real purpose of gathering together in a symposium.

Again, welcome -- and may the union of Research to the Social and Economic Aspects of Water Resource Quality be fruitful.

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*Officer-in-Charge, U. S. Department of Health, Education and Welfare, Public Health Service, Division of Water Supply and Pollution Control Program, Pacific Northwest, Portland, Oregon.

INTRODUCTORY REMARKS

E. F. Eldridge*

We are not running out of water. There is just as much water in this country today as has been here for ages. Nevertheless, we are rightly concerned about the adequacy of this resource to meet our growing demands. There is a considerable question about our ability to substantially add to the natural supply of water and in the foreseeable future, at least, this is not our problem. Our problem is water resource management. We can either waste or conserve this resource. Our choice obviously must be to conserve.

Conservation of water cannot be confined to quantity alone. Large quantities of water are of little value for most of our major needs, if not of the desired and necessary quality. Witness the ocean. Water resource management must, therefore, be concerned with quality as well as quantity.

A water-resource quality management program has at least three general aspects, namely, the technical, the economic and the social. I believe that it is true that we who in the past have been involved in water quality control (pollution control) have given priority to these aspects in the order of (1) technical, (2) economic, and (3) social. In fact, we have given major attention to the technical, limited attention to the economic and almost none to the social. This we have done in spite of the fact that, right or wrong, social and economic factors govern our decisions more often than do the technical.

Recognition of this fact has prompted this symposium. And since research is the key to progress in any activity, our discussions today will be directed toward, but not confined to, a determination of the needs for knowledge on the social and economic aspects of water pollution (water-resource quality) control.

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*Physical Sciences Administrator, U. S. Department of Health, Education and Welfare, Public Health Service, Division of Water Supply and Pollution Control Program, Pacific Northwest, Portland, Oregon.

THE WATER QUALITY PROBLEM
POLICIES, CONCEPTS, AND RESEARCH NEEDS

Leonard B. Dworsky*

Social and economic research addressed to the problem of water quality is sorely needed. This seminar reflects the efforts of the Department of Health, Education, and Welfare to stimulate and encourage this effort. The Division of Water Supply and Pollution Control is keenly aware that knowledge to be derived from such research is important to furthering its mission of keeping clean the nation's water resources.

For some of those present there is little need to dwell on historical developments. There are, however, many people here who have not been closely associated with this problem of water quality management, or water pollution control, and a brief setting of the background -- a resumé of how we have arrived at where we are -- seems justified if we are to have a full understanding of the problems confronting us.

In opening this seminar, I have been given the task of outlining the water quality problem and the working policies and concepts underlying our national pollution control program.

I plan to do this by reviewing the mainstream developments of the pollution problem, and by comparing this development with other major aspects of water resources activities. Then I want to reconsider the problem from the viewpoint of four specific areas, namely, enforcement, engineering and planning, financial assistance, and quality goals for safeguarding water resources. For each of these areas, I propose to summarize the guiding working policies and concepts. Finally, I want to outline a number of research tasks related to the social and economic aspects of these facets of the water pollution problem. Some of these will be developed in greater detail by other speakers, but I hope to touch upon a few as my contribution.

There has been a sense of awareness, and sometimes urgency, about the need to control and develop water resources in the nation from our very beginnings. Carl Sandburg notes Mr. Lincoln's support for river and harbor projects in the mid-19th Century as a congressman. At about the same time, new ideas began to cascade from widely divergent sources. In 1849, Thoreau, after a week on the Concord and Merrimack Rivers, and later at Walden Pond, wrote on Man's response to nature and water. Also, Dr. John Snow, in London, was finding that water had another relationship -- that it could transmit cholera and be a hazard -- to Man. In the vital 60's of the last century, Pasteur founded the new science of bacteriology.

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*Assistant to the Chief, Division of Water Supply and Pollution Control, Public Health Service, Washington, D. C.

Although scientific knowledge of importance to our subject was just beginning to emerge by 1880, the Congress had been concerned for nearly 50 years with problems of flood control. During the ten-year period following the Civil War, over $40 million were spent on river and harbor improvements. The establishment of the Mississippi River Commission in 1879 marked the beginning of direct federal involvement in flood control -- although it remained tied to navigation until appropriation acts of 1917 established flood control as a function in its own right. By the time the Reclamation Act of 1902 was passed, private reclamation efforts had established 20,000 private enterprises providing water to 9.5 million acres of land with an investment of $250 million.

In the late 1880's the Lawrence Experiment Station in Massachusetts had been established. The year 1901 saw the establishment of the Public Health Service Hygienic Laboratory and the establishment of the Division of Scientific Research. Eleven years later, in 1912, the Congress debated whether there should be a laboratory to undertake water pollution research, and finally decided to establish one within the Public Health Service, located at Cincinnati, Ohio. By 1914 the first drinking water standards were established, providing a guide about the quality of water Man could consume without causing illness. At about the same time (1912), Congress also argued whether or not there should be some federal responsibility for enforcement of pollution control, and decided against it, thus laying this matter over for another 36 years.

During the 1910-1920 period, the Cincinnati laboratory began to develop the fundamental knowledge of what happens to pollutants in a flowing stream. The basic outlines of waste treatment technology began to come into better focus. But during this period, the major effort was placed upon protecting the drinking water. There was more concern with controlling illness than with controlling pollution of our waters. This generally was the nation's pace throughout most of the first half of the 20th Century, with minor variations created by public works stimulation during the 1930's and a nearly total absence of progress in pollution control during the war years of 1941-45.

By 1927 the Corps of Engineers had received authority to undertake comprehensive basin-wide water studies throughout the nation. During that decade, trial surveys were initiated in Ohio and Illinois to test the stream purification theories so far developed at Cincinnati. In 1939, the Public Health Service and the Corps of Engineers jointly entered upon the first comprehensive pollution study of a river basin -- the Ohio River Survey, (H.D. 266, 78th Congress, 1st Session). Under a board consisting of Major General Thomas M. Robins (Corps of Engineers), Professor Abel Wolman (Johns Hopkins University), and Sanitary Engineer Director Ralph Tarbett (Public Health Service), a report having continued reference value was produced.

The first major federal enatctment to control water pollution was passed in 1948 (PL 845, 80th Congress). By this time, the problem was universally acknowledged as serious. The economy, surging forward as a result of the war and postponed consumer buying, was also reflecting a new industrial technology. Population and industrial growth, a new commitment on the part of the nation to provide jobs for its manpower, new purchasing power, increased leisure time, and a demand for outdoor recreation all contributed toward establishing the need to keep the nation's water resources clean.

In retrospect, viewing this problem as well as others, it is worth reminding ourselves that we are a pragmatic nation -- and that we do act on important problems when it becomes clearly necessary to do so. We took action on the flood problems in the latter part of the 19th Century because the Mississippi Valley flood threat had to be met. The 1902 Reclamation Act came into being to meet the problems posed by the large land reclamation tasks which confronted the West, and which could no longer be avoided. Historical review bears out the conclusion that there was no consistent desire, philosophically, to assign these tasks to the Federal Government. Other devices, such as the early Swamp Lands Acts, the Carey and Desert Land Acts and other approaches were attempted to meet these problems through state action.

With respect to the Water Pollution Act, the record shows that for a half century, federal participation was held in reserve. One may conclude that the Federal Government's participation in the pollution problem represents, in the long-term trend, another of the actions necessary to develop a mature, balanced program to protect public health and conserve natural resources within the framework of our federal system.

Thus, water pollution control, in comparison to other federal water development programs, is a late-comer. This program has no long history in planning, in financial aid, or in enforcement authority. These originated in the 1948 legislation in a modest way. The beginning of a stronger research effort also traces back to 1948.

All of these early programs were new within the federal establishment and were faced with great constraints in terms of budget. Nevertheless, after some 14 years, we have a right -- states, localities, Federal Government, and the public -- to be proud, but not complaisant, of our accomplishments in water pollution control. Few, if any, nations have had to meet problems of comparable complexity, or have set goals quite as high as ours. Perhaps this is because no other nation has compositely the same industrial setting, abundance of materials, leisure time, and the drive for remaining close to Nature.

The tasks we face are not merely of an engineering character. We are seeking primarily important social gains and a sound basis for future economic development. Social and economic research in this field must be sensitive to a wide range of values and goals.

To better view some of the social and economic problems related to water pollution, let us consider the program elements of enforcement, engineering and planning, financial assistance, and water quality goals.

Enforcement

As early as 1912 Congress considered, but decided against, placing with the Federal Government the responsibility for enforcing water pollution control. Up to that time, pollution was largely a public health problem and remedies were sought through the police powers of the state. Certain federal controls regarding floating debris in coastal waters already existed in the navigation laws of 1889 and 1899. Extensive use of oil during World War I resulted in enactment of the Oil Pollution Act of 1924, and its enforcement was assigned to the Corps of Engineers. Today oil pollution on the oceans and seas is a world-wide problem -- one to which the United Nations has addressed itself.

The 1948 Water Pollution Control Act provided for federal control of interstate stream pollution which endangered the health or welfare of people in a state other than the one in which the pollution originated. The power to enforce, however, was contingent on the consent of the state creating the pollution.

In only one situation -- where a small stream flowing from Arkansas into Louisiana was polluted from oil wells -- was the Act used. It did mark a breakthrough in implementing the federal enforcement authority. But, as a whole, the enforcement provision under the Act of 1948 was weak and inoperable. As a result, there was a strong demand for more effective legislation, which came in 1956, and which was further broadened and strengthened by the 1961 amendments to the Water Pollution Control Act.

When requested, or whenever the Secretary of Health, Education, and Welfare believes an interstate problem exists, a conference between the states concerned and the Department of Health, Education, and Welfare is called, to present the problem and seek a solution. Generally, such conferences have resulted in agreement on objectives and a time schedule to accomplish them. The program is then referred back to the states for accomplishment. If progress is not satisfactory, the Secretary of Health, Education, and Welfare then calls a hearing before a board~~, on which no officials of HEW may be members~~. On the basis of the board's findings, the Secretary of HEW can order the city or industry to take action to control pollution. If no action is taken after a specified time, the Secretary can refer the matter to the U. S. Attorney General. The conference technique was suggested by the states to provide close consultation with states prior to a formal finding by the Federal Government that pollution exists. It has proven highly effective.

The 1956 legislation provided a tool that the states and the Federal Government have used with good effect. But problem areas continued to exist within states on intrastate streams that were outside the authority of the 1956 Act. The 1961 amendments extend the federal authority to interstate navigable waters, and with the state's assent, to intrastate waters. This was in response to the need to fill gaps that existed in the old Act. Thus has the Federal Government's enforcement role evolved during the past 14 years. The current position of the Federal Government on enforcement was stated by Assistant Secretary James Quigley of Health, Education, and Welfare in a speech last year. 1/ He said...

1/ Clean Water and The New Frontier, Address before 39th Annl. Convention and First Conservation Conf., The Izaak Walton League of America, Chicago, June 22-24, 1961.

"...the new Administration, the New Frontier, if you will, is ready, willing and able to come to grips with the hitherto unfaced question of the scope and sweep of national water pollution control policy. The real problem of 'fish or progress' cannot be avoided much longer. The Federal Government must take the lead in establishing a national policy on water pollution control which is comprehensive in its scope and uncompromising in its implementation. Existing law actually authorizes the Federal Government to act with regard to interference with any and all legitimate water uses, whatever purposes they serve. Up to now, however, that authority has not been actively pursued. It certainly has not been pursued at the state or local level. And so, I suggest that our only alternative is to pursue it vigorously at the Federal level.

"I believe that any degradation of water which can interfere with a legitimate use is contrary to national policy. I believe this policy is implicit in existing law, which requires not so much further amendment but substantially increased implementation. No water pollution control law - Federal, State or local - should by its terms or by interpretation be held to require, permit or condone any type of water pollution.

"There are still some who hold to the belief that the utilization of a stream as a receptacle of waste is a legitimate use of water, consistent with water pollution control policy. Such a belief finds its basis in the fact that water courses have been used for this purpose all the way back to antiquity. Whatever may have been acceptable or unavoidable in years past, however, it is quite clear that our goal now and in the years ahead in an age of vast industrial expansion and rapid urbanization must be to prevent any sort of water pollution.

"This is the new scope of national water pollution control policy on the New Frontier. We intend to actively put into effect that National credo established at the National Conference on Water Pollution last December, that "users of water do not have an inherent right to pollute; users of public waters have a responsibility for returning them as nearly clean as is technically possible; prevention is just as important as control of pollution."

Federal enforcement is a fruitful subject for research by political scientists, students of law, and others. Opportunities exist to study federal administrative machinery; to subject the process itself to critical evaluation; to compare its effectiveness with that of state and interstate entities; to study devices for coordinating state and federal enforcement as a working tool for both state and federal agencies; and to consider the value of joint federal-state enforcement operations based on state enforcement of national requirements, a procedure now existing in other activities in which the federal and state governments share responsibilities, applied to the water pollution control field.

Engineering and Planning

Engineering, the process of applying scientific knowledge; and planning, the process of assessing available resources and future needs and developing programs to meet the needs, are both highly dependent on research in the field of water pollution. In terms of today's problems, considering the limitations of existing technology to provide "complete" sewage and waste treatment in fact; to meet problems of detergents or other persistent chemicals; and the inability to control such nutrients as phosphorus and nitrogen; the research effort mounted by the nation during the past decades, it must be concluded, has been shortsighted. As we now know, this is not an isolated shortcoming. We also failed to forecast accurately population and industrial growth, and the effects of new technology on American society and its resources.

As we move through the 1960's, time in which to work out new engineering processes and get them into use is severely limited. Such research and technological limitations complicate planning and altogether they present a major issue to physical and social scientists alike.

Beyond the pioneering Ohio River Report previously mentioned, a few small basin plans produced by private engineering firms, and some limited state pollution control agency activity -- comprehensive planning for water quality management remained almost static during much of the 1950's. Major planning efforts are now underway to help meet new problems and new requirements.

The Kerr Committee (Select Committee of the U. S. Senate on National Water Resources) pointed out in 1961 that planning is essential if the nation is to meet its future water requirements. It suggested, and the President has asked, that all federal agencies work toward the development of comprehensive basin-wide water plans by 1970. The Public Health Service is participating in that effort. Today planning programs are underway in the Columbia, Ohio, Arkansas, Colorado, and other river basins.

There is room, however, for improvements in the planning process. On the basis of these planning operations large sums of money will be spent during the next two decades. Research, for example, must determine to what extent we correlate the degree of waste treatment and the dilution of treated wastes through reservoir storage for stream flow control to best serve pollution control requirements. It might consider the place of the private sector of the economy in multipurpose developments involving this problem. It must seek a new treatment technology that might reduce the need for reservoir stored dilution water.

The planning effort needs new thoughts from many new sources. We must better identify the significant planning elements. We must develop the economic rationale for the planning process and the systems analysis to manage numerous and complex variables. We must study deeply the means through which the plans, once developed, will be implemented. The universities are best geared to assume the major role of research in water pollution control needs. With isolated exceptions, however, there is little effort, little interest, and seemingly little understanding at the university level of these needs. The tasks are many, and support for such studies is available from numerous sources.

Financial Aid

Federal financial aid, either directly or through land grants to states and private enterprise, has a long history. Roads, canals, river and harbor navigation improvements, and later drainage, flood control, land reclamation and erosion control have had such support. Until the 1930's such aid for water pollution control was unknown. Localities and industries creating the problem were responsible for its solution and financing.

Federal financial aid during the depression years was undertaken, not primarily to assist in pollution control, but to make jobs for people. During the war years of the 1940's, financial aid aimed at helping war-impacted municipalities was supplied to pollution control by the Lanham Act. Legislation proposed in the post-war period looked back to the progress of the 1930's and federal aid became a part of such proposals. Legislation drafted during 1946-47 proposed federal assistance to cities and to industries for building waste treatment works, recognizing that the nation had to meet this problem in some effective way.

As a result of numerous bills, the 1948 legislation concluded with the Senate proposing $100 million for low interest loans to municipalities only; the House proposed $20 million and the compromise bill authorized $22.5 million per year. However, no appropriation for this purpose was made during the first seven years of the law, 1948-1955. In 1956, Congress authorized and appropriated $50 million for an incentive grant program to aid cities in constructing sewage treatment plants. This has continued to date, amended in 1961 to increase the grant sum to $80 million per year and ultimately to $100 million per year.

The Advisory Commission on Intergovernmental Relations report on water and sewage works in connection with metropolitan problems raises a new question. The Commission has asked the President to request his departments to review the problems of industrial waste pollution and consider incentives to facilitate industry pollution control to safeguard water quality. Some six or eight states have already effected state and local tax programs to do so.

It is a question that needs much study. What are the opportunities to use the tax structure to assist industry? Water use taxes for those industries using public waters have been suggested. Would loans be of any value, or a clear-cut grant subsidy? The Congress could effectively use studies in depth identifying all the various possibilities as it debates and determines public policy. These are research challenges that universities and others can accept.

A number of other opportunities are open to research on the general problem of financing. The relationship between federal and state governments in the water pollution control financial aid program is worthy of study. Generally, federal financing programs supporting capital construction at local levels lean over backward to secure the federal investment, with attendant overhead costs. Rarely, too, are decisions about where federal moneys go left to other hands. A study of the administration of these grant funds can provide new insight into organizing and administering a federal-local grant program with concomitant strengthening of state's activities. Such a study might compare this program to others for overall effectiveness in terms of efficiency, economy, federal-state relations and a general strengthening of the federal system. As presently administered, following a state-by-state allocation based on a legislative formula, the state water pollution control agency decides where the money goes, and establishes project priorities. State standards of treatment works are accepted. The federal role is purposely minimized, with attendant and significant savings in administration overhead and supervision.

Another research task would be to examine the present relationship between the comprehensive planning function of the water pollution control program and financial incentives available to carry out the plans. (Under Section 6 of the Water Pollution Control Act, grants are to be made for projects within the framework of a comprehensive water pollution control plan.) How to bring these program aspects together while preserving the states' role in establishing priorities is a question worthy of study. Suitable studies might devise better methods in fund administering, and in the way states participate and determine priorities.

Still another useful study relates to the fact that municipal waste treatment is usually undertaken on the basis of a city's readiness to build, in terms of local planning, priorities, and financing, and not in terms of a basin plan to realize optimum water quality values. Under this situation, the full benefit of public and private expenditures are not realized.

Finally, to consider the key issue: how clean do we want our waters to be? Mr. Quigley's statement provides a Federal Government viewpoint. At state level there are significant variations in policy, and the administrative means to carry out these various policies are widely divergent.

Some states avoid clear public statement of desired water quality goals because this is thought to create administrative problems. Others have established extensive stream classification schemes with clearly identified quality goals. Another group has settled for water quality goals that may be unrealistic in terms of future needs and over-all regional or national values.

The National Conference on Water Pollution (1960) and the Water Pollution Control Advisory Board, having representation from industry, conservation, and public health interests, citizen groups and local, state, and county officials, have indicated that the best tools available in our technological armament should be used everywhere to produce the best treatment possible to conserve waters for the best uses.

Today, in contrast with the 30's, many states are already seeking that result by establishing a policy of secondary treatment (about 80-90 per cent removal of organic wastes). Additional high cost treatment -- to cover perhaps the last 10 per cent -- may be required more extensively in the future.

These matters pose important research tasks. What are the costs to the nation if high quality goals are met? What are the losses if they are not met? How much can we rely on market place economic analysis? How can we better identify social values not measurable directly in dollars? What are the total consequences of polluted waters? What benefits would accrue from an effective basin-wide cleanup program?

I hope that these trend lines of development have provided a useful background to those not previously familiar with the general subject; that this discussion of the four areas (enforcement; engineering and planning; financing; quality goals) has usefully illustrated the nature of the subject problems; and that the research suggestions will prove worthy of thought and followup action by interested students and others.

DISCUSSION

Q. I would like to pose a question with respect to federal aid. Originally federal aid was used as an incentive to get state and local interests into water pollution control. I view it now as a sort of requirement to build up interest on local and state water pollution control problems. Will future federal aid be an effective means of building this local interest? Do you think this is a healthy tendency from incentive to requirement?

A. It started as an incentive, it still continues as an incentive, but there is a significant shift in point of view. The Federal Aid Program was started on the premise that the cities which created pollution had a responsibility for taking care of it and essentially this still remains the general accepted policy. However, in terms of the national interest, one must begin to view this as being a sharing task to which the Federal Government assumes not merely an incentive task but also a basic responsibility because of the widespread values that are contributed by good water. Actually, what we are saying now is that the Federal Government representing the total people is sharing in this task with the state and local governments. The principle is that of sharing at all levels of government because we all have an interest in this matter.

SOCIAL FACTORS IN WATER-RESOURCE QUALITY-CONTROL POLICIES AND PROGRAMS

Roy F. Bessey*

INTRODUCTION AND SYNOPSIS

This exploratory paper looks toward correlated research and planning by many agencies and interests with the view of bringing out the great social needs for, and the broad and close interrelationships of water supply and pollution control and other water resource uses in, the society. It is presented with the hope that it may help to stimulate thought and discussion, and relevant public, private and educational research and study, to such ends.

By way of introduction, some basic premises of the presentation may be outlined:

1. We are concerned with "social" aspects in the broad sense -- as including economic and political as well as sociological facets. We are concerned with societal objectives for advancing human well-being and an increasingly livable environment. It is assumed that social purposes -- relating to health, safety, welfare, productivity, and to amenable lives -- are of fundamental and often dominant importance in resource development.

2. We are concerned with a total and integral problem of contamination of water, land and air from many sources affecting many areas and regions, and the nation as a whole. The problem is expanding in magnitude and intensity; with a high rate of growth in population, urbanism, and production, and a lagging rate in resources conservation and development, the needs in water development are outrunning the means of meeting them.

3. In such a problem we are concerned with a total environmental context -- with water supply and pollution control in a geographic, economic, biotic and ecological community. We are concerned with protection and improvement of environment to the social ends mentioned and with the effects of pollution control in arresting decay and decline and promoting vitality and amenity in the community.

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*Consultant in Regional Planning and Water Resource Development, Portland, Oregon.

4. Concerned as we are with a total environment, it is presumed also that the full resources of the interrelated natural and social sciences should be brought to bear in unified fashion in the accumulation of relevant knowledge and in its application to situation appraisals and plans of action for societal improvement.

5. Research in social sciences -- including geography, regionalism, psychology, anthropology, sociology, economics, politics, behaviorism, and planning -- is of high importance in giving meaning and direction to the vital effort in the needed expanded work in the physical sciences.

6. The river basin and the region provide a logical environmental setting for a unified application of scientific research and skill in the essential conservation and development of water and related natural resources.

7. The present is seen as a very crucial time -- a time of special need, opportunity and challenge -- in the marshalling of knowledge and scientific and material resources for meeting an expanding threat to our social health and welfare. A breakthrough is called for in the advancement of resources protection, conservation and development.

In the body of the paper effort has been made briefly to outline the social background and necessities of water supply and pollution control policies and programs. Highlighted are (1) some major social aspects and needs, (2) the place of water supply and pollution control in a comprehensive resources development plan, and (3) the kinds of socio-politico-economic research needed in an effective all-science attack on the problems.

The concluding section reviews such research needs and presents an outline looking to a comprehensive coverage of the field. Finally, the conclusions reiterate the view of the wholeness of the problem of environmental contamination and of the parallel need of unity in the use of countervailing resources of purpose, knowledge, wisdom, technology and materials.

THE SOCIAL AND ECONOMIC NECESSITIES OF A WATER SUPPLY ADEQUATE IN QUANTITY AND QUALITY

1. Background of general public and national interests.

Basically and realistically, water must be considered as essential raw material for industry and ingredient of vital human services -- as veritable life substance. An adequate supply, available in quantity and quality for multiple uses, is a community, regional and national necessity from standpoints of health, welfare and economic and social security. With land, materials and energy, it forms the natural resources base for an advancing economy and society.

The maintenance of water quality -- pollution control -- has long been recognized as a matter of public concern, one for which the community has usually accepted a public utility responsibility. With population and industrial expansion, the area of public responsibility is constantly widening -- from urban community to metropolitan area, and now to the river basin and region. As has been well brought out in water resource policy studies of a Senate Select Committee, and others, those responsibilities extend upward from local to state and federal government. 1/

Awareness of water pollution as a serious urban-area problem goes back about a century, when it was linked with typhoid epidemics. Federal interests heightened at the turn of the century, research dealing with the effects of pollution on men was undertaken by the Public Health Service in 1901 and extended in 1912, when legislation providing for investigations of lake and stream pollution was passed. Later, in 1926, legislation was passed for oil pollution control. Generally, however, progress toward any concerted national attack on pollution was limited, although a number of separate bills were introduced in the Congress over a period of years.

While the Federal Government has carried forward its role of research, the states, under their police powers, augmented from time to time by special legislation, have carried the brunt of pollution control action. For most states, however, the efforts were essentially piecemeal, and far too little was accomplished. 2/

A modern view of pollution control as a broad social problem of regional and national proportions -- calling for integral consideration with other resource problems -- was established by cooperative appraisals led by the national resources planning organization of the 1930's.

1/ Select Committee on National Water Resources, U. S. Senate, Report, No. 29, 87th Cong., 1st Sess.

2/ Leonard B. Dworsky, U. S. Public Health Service, Comprehensive Planning and Water Quality Management, 1960.

In its general resources situation review of 1934, the National Resources Board said that there was little question but that a number of problems of quality of water and of pollution deserve the coordinated study which only the Federal Government can give them. It suggested a number of lines of approach -- as in coordination in collection and analysis of data, in study of influences of stream control and development, and in study of advisability of federal control of interstate waters with special reference to domestic, industrial and mine pollution. 1/

A few years later, the National Resources Committee set up a cooperative review under its Water Resources Committee. The resulting report, providing national perspective, said that "water pollution affects man in a variety of ways, and none in a degree that can be expressed satisfactorily in monetary terms. Human health may be impaired and life may be lost; the supply of aquatic life may be reduced; the suitability of water for domestic and industrial use may be impaired; the life of bridges and other structures may be shortened; and recreational use of water bodies and adjacent lands may be hampered or prevented. These effects may result from deposits of foreign substances of four major types: (1) chemically inactive substances, (2) active putrescible substances, (3) bacteria, and (4) chemically active non-putrescible substances." It recommended federal assistance in the form of grants and loans to public bodies and loans to industries. 2/

The Water Resources Policy Commission, in 1950, was also positive about the national concern with the pollution problem, citing water shortage and pollution as "accomplices in retarding progress." "No informed person" -- it said -- "can fail to recognize the direct relation . . . . for polluted water is almost as bad as no water at all, and where it endangers life or health, momentarily worse." 3/

A very little later the Materials Policy Commission further stressed the needs for water in quantity and quality. It said

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1/ National Resources Board, Report, 1934.

2/ National Resources Committee, Water Pollution in the United States, 1938.

3/ President's Water Resources Policy Commission, A Water Policy for the American People, 1950.

that the planning and development of water resources must comprehend all aspects of collection, conservation and use, that growing needs can be met best if water requirements are treated as one of the major objectives of water policy in each area and for the whole nation, together with all other uses of our water resources. 1/

Over all of these years, private and non-federal public interests have offered considerable resistance to the assumption of broad federal responsibilities in pollution control. This resistance movement is perhaps best epitomized in the report of the Task Force on Water Resources and Power of the second Hoover Commission. 2/ There a group of proposals sought policies aimed at increasing local responsibilities and restricting national roles in such matters as flood control and power, as well as pollution control. In the latter instance, federal activity in pollution control would have been limited substantially to that caused by federal installations.

The Senate Select Committee on National Water Resources, in its notable 1961 review of water need and policy, expanded upon the comprehensive view of water supply and pollution control. It saw prosperity and even survival at stake in meeting growing demands for water. It noted the problems relating to the several active and inert pollutants, adding emphasis on new chemicals and radioactive substances, sediments, and heat. It saw pollution-control progress as lagging behind the growth in population and production, the growth of demand for water and the production of wastes, as well as behind that of regulation of flow of rivers for disposal and dilution. It saw the need for augmented research in a number of fields, and for the improvement of techniques for dealing with increasingly significant types and quantities of waste that cannot be handled by existing methods of treatment. It recognized the need of public understanding and support in the job to be done. It emphasized the importance of comprehensive planning of water development with a view to advancing economic opportunity and improving the quality of life for the people. Generally, the

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1/ President's Materials Policy Commission, Resources for Freedom, 1951.

2/ Commission on the Organization of the Executive Branch of the Government, Task Force Report on Water Resources and Power, 1955. Also, Committee on Government Operations, U. S. House of Representatives, Hearings, Water Resources and Power, Milwaukee, Wis., Nov. 7-8, 1955.

Select Committee studies threw much new light upon water supply and pollution control needs in the context of the total national water resources interest, policy, and development. [1]

In spite of such comprehensive views of danger and need, and of the frequent introduction of legislative proposals, progress in the advancement of national policies and programs has been slow. The Water Pollution Control Act of 1948 established a policy of backstopping local action and control. While reiterating the policy of recognition, preservation and protection of the primary responsibilities and rights of the states in controlling water pollution, it also proposed to support and aid technical research, to devise and perfect methods of treatment of industrial wastes, and to provide technical services to state and interstate agencies and to municipalities in the formulation and execution of their stream pollution abatement programs. This Act was amended and strengthened in 1956 and then further in 1961.

This last-mentioned law marked a longer step toward maturity in a national pollution control policy and program. It showed increasing concern with rapidly-growing pollution problems. It reiterated and strengthened the policy and program of grants, loans and technical assistance in state and local control. Further, it provided for the preparation of comprehensive plans for abatement in surface and underground waters. Also, very significantly, it looked to the advancement of federal storage projects for the regulation of streamflow in the interest of water quality control, with the proviso that such storage and water releases shall not be provided as a substitute for adequate treatment or control of waste at the source. This legislation further provided that the value of such storage shall be taken into account in determining the economic value of the project and that allocations of costs be made to the purpose of water quality control.

Of very direct interest from the research standpoint, the legislation provided for the establishment and operation of research and field demonstration facilities and for the carrying out of research programs in pollution and treatment technology.

It also strengthened the means of enforcement against pollution.

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[1] Select Committee on National Water Resources, Report, op. cit., also Committee Prints, Nos. 1-32, Water Resources Activities in the United States, 1960.

Over-all, an important effect of the recent amendments will be a reinforcement of pollution control in the broader scheme of comprehensive river-basin planning and development. Appreciation of this need has been growing over a period of years, particularly in the interagency river-basin planning movement since 1946. 1/

2. The present situation, problem and need; the growth of demand for water supply and pollution control.

The scope and magnitude of the water supply and pollution control problem have expanded very materially, and the needs have become increasingly critical, since the broad appraisals of a quarter century ago or even that of the Presidential policy commission studies of a dozen years back.

Much of the pollution growth is an extension of older trends -- with strong increases in population likely to continue for at least a few decades, with large concentrations in urban and industrial development, and with expanding output and consumption of materials, goods and services. But new factors of large physical and social significance have emerged. The more portentous of these involve the greater production and use of persistent and cumulative toxic chemicals in fertilizers, pesticides, herbicides, and detergents. 2/ The present and prospective expansion of production of atomic wastes as a source of contamination, and of unwanted heat, is a similar problem. Waste heat may be utilized in the generation of electric power, as in the current plan for development of dual-purpose reactors at Hanford, Washington. In general, however, the anticipated large-scale nuclear generation of electrical energy may be expected to intensify the problem of safe disposal of such wastes.

Generally, a worsening situation underlines a need for extended and accelerated research in physical, ecological, social and environmental fields. As already noted, the production of waste is far outrunning the means of disposal, and the pace of physical growth allows no time for natural ecological readjustments.

In concrete terms, the Senate Select Committee has summarized 3/ relevant factors and estimated requirements in the physical

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1/ Leonard B. Dworsky, op. cit.

2/ Note Rachel Carson's Silent Spring, 1962, and the burgeoning controversy about the nature and extent of this environmental threat.

3/ Senate Select Committee, op. cit., Committee Print No. 32, Water Supply and Demand.

development of water supply and pollution control capabilities. The following significant national figures (for the 48 contiguous states) should be useful for the purpose of social perspective, as well as for the evolution of development goals:

Year:	1960	1980	2000
Population (millions)	180	244	329
Urban Population (millions)	126	193	279
Gross National Product ($ billions)	519	1060	2200
Water Withdrawals (billion gal./d.)	350±	559	888
Water Losses (billion gal./d.)	110±	119	156

The water withdrawals might be considered against a presently available water supply of about 1100 billion gallons per day.

For the Pacific Northwest the corresponding significant estimates are:

Year:	1960	1980	2000
Population (millions)	5.9	8.3	12.4
Urban Population (millions)	3.8	6.2	10.1
Regional Gross Product	---	---	----
Water Withdrawals (billion gal./d.)	27±	35	60
Water Losses	12.7	13	15

These regional withdrawals and losses might be considered against a presently-available supply of about 143 billion gallons per day.

The possible storage development posited by the Select Committee also is very significant in the perspective of water development. For the country (48 states) a "minimum cost" program of development would call for about 440 million acre-feet of storage above the present level of about 280 million by the year 2000. For the Pacific Northwest such a program would call for about 20 million acre-feet above the present 30 million, or a total of about 50 million acre-feet. The capacity would make about half of the natural flow available all of the time.

In a further rough weighing of future development of storage for multiple purposes in the Pacific Northwest (principally in the dominant Columbia River system), a storage goal of the general order of 50 million acre-feet has already been broadly justified for purposes of power and flood control. 1/ Under such a general condition the discharge under the Columbia's record flood of 1894 (one of about 100-year frequency) would be about cut in half (from about 1.2 million cubic feet per second to about 0.6 million).

Since storage facilities and uses for multiple purposes will not be separable, some leading questions might be posed for research and study purposes: To what extent (presumably a large one) would storage capacity serve jointly, without major conflict, between the major storage purposes? Should higher goals be set for prudent planning purposes, making allowances for larger-than-anticipated consumptive uses and losses, for a lower degree of sewage and waste treatment, for new contingencies in waste disposal, and for higher benefit values in water supply, flood control, power, recreation, and other uses?

For example, an 80 million acre-foot goal for the Columbia River system in the year 2000 might be hypothecated, and perhaps found to be warranted. This would provide for a storage capacity of about half the supply, with added (although probably not proportionately added) major values in flood control, power and water supply. In flood control, for instance, the record Columbia flood flow would be cut to about one-third, and the system would be better prepared to meet the much greater floods of lesser frequency.

The foregoing illustrations are, of course, only crude approximations of the possible degree of storage development, sketched with a very broad brush. However, hypothetical goals of this kind should be set up as useful guides in research and planning for the more specific location, layout and use of storage in surface reservoirs and also significant underground reservoirs (such as that of the great upper Snake basin) for multiple purposes from flood control to recreation. In the field of water supply and pollution control, they provide a long foresight for the research and planning for the larger-scale, more integral systems of water supply and distribution, waste treatment and disposal, water drainage, etc., seen as needed to meet the greater and more complex needs of the future.

1/ U. S. Army, Corps of Engineers, North Pacific Division, _Water Resource Development, Columbia River Basin_, 1958.

Assumptions of the kind should also be helpful in study of the relative benefits of storage for the various uses, including water supply and pollution control.

The relation of withdrawal to supply in the Pacific Northwest, as compared with other national situations, is also a matter of economic and social significance warranting further study. Withdrawals crowd upon supply to a lesser extent in this relatively water-rich region than in many other regions and in the United States (48-state basis) generally. The withdrawal-supply ratio for the Pacific Northwest is now less than 20 percent while that for the country at large is over 30 percent. In western basins generally, withdrawals are already considerably in excess of supply, while some others there and elsewhere will have high ratios within the 20 or 40-year periods considered in the Select Committee study. 1/

As national growth and development trends continue and pressures on water supplies increase, the relative disparities in water supply and demand seem likely to lead to notable interregional differences in economic and social potentials -- with pushes from water-deficient areas and pulls toward the better-supplied. The effects can hardly be gauged with accuracy, but some are likely to be strongly felt, as in the capacity for waste disposal, in the location of industries of high water use, and in the efficiencies and amenities in community facilities and services. The Pacific Northwest, of course, is in the better-supplied category.

3. The general situation in summary; the need for breakthrough in research and development.

The older general views of the situation and of the need of concerted attack -- as brought out by National Resources, Water Resources, Water Resources Policy, and Materials Policy studies -- are still highly valid but new urgencies have been added as indicated. The present and potential dangers to life and environment from the mass production and use of persistent chemicals and from radioactive materials have been highlighted.

Another kind of urgency has been added by the presentation, through the Select Committee, of a clear, if very approximate, quantitative view of the vast requirements for a supply of water

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1/ Select Committee Print No. 32, op. cit.

of controlled quality for all purposes and for all regions. 1/

The urgency of a broad program of research and planning is further stressed by the determination of the national administration to develop comprehensive development plans for all of our river basins by 1970. As already noted, this is a most important planning avenue to the realization of adequate progress in water and pollution control programs.

Quite clearly then, we are at a turning point -- a time in which to reappraise and replan our research and development policies, goals, methods, plans and programs. The immense scope and complexity of water supply requirements in the economy means that we must turn definitely and firmly to river-basin settings and plans, to coordinated action between purposes, goals and agencies, and to water-supply and drainage systems rather than to piecemeal plans and projects for meeting those needs.

We now have strengthened legal and program capabilities as a result of the amended pollution-control and water-supply acts.

Thus, the situation presents a renewed and more promising opportunity and call for new orientation and for concerted action in meeting one of the nation's larger problems and needs. We should have a clarified and reinforced understanding of physical need and of economic, political and social concepts suited to the need and the time. In this connection, the relatively slow reaction of the general public to water "shortage" and pollution as dangers and problems of national significance suggests the importance of knowledge of the public's attitudes, motivation and "behavior" on one hand and of the public's information relating to its possible choices and decisions on the other. Here is a general challenge to government, educational systems, industry, and general public and a very specific challenge to their research agencies in the natural and social sciences.

WATER SUPPLY AND POLLUTION CONTROL IN A COMPREHENSIVE PLAN OF RESOURCES CONSERVATION AND DEVELOPMENT

The situation and needs briefly outlined here indicate in general terms the kind of conservation and development goals, policies and programs required in a renewed and reinforced attack in the water supply and pollution control field. The

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1/ Ibid.

kind of development measures required to meet these and related needs is, in turn, highly relevant in the approach to a well-directed and adequate, many-pronged and comprehensive program of research in water supply and pollution control.

Some basic principles, many of them widely recognized, in the planning and development of water and related land resources, may be illustratively outlined here as affecting directions of socio-economic research. These principles will warrant study in themselves with a view to their adaptation to water supply and pollution control in particular.

We have touched upon a principle of unity -- of consideration of interrelated multiple resources in a total economy and environment. As also indicated, the principle of comprehensive, multiple-purpose, balanced and coordinated river-basin and watershed conservation and development is widely applicable to modern water supply and pollution control solutions.

The basic principles of conservation of both material and human resources -- including wise use and all feasible renewal, salvage, and re-use -- will apply widely in water supply fields.

Broad principles of economic justification of development -- as of benefits in excess of costs and of optimum use of resources -- will apply in water supply fields. But in view of the nature of this need it will be especially important to give full consideration to social benefits and costs. Application of this group of principles will call for a careful rationalization of stock or arbitrary methods of evaluation, justification, and cost allocation.

The urgency of securing public and governmental understanding of social need in water supply and pollution control underscores the need of a very purposeful and realistic approach to the authorization and financing of projects and programs for these purposes. Such purposes are often lost sight of in the mathematical intricacies of conventional economic analysis. Moreover, there have been strong tendencies to discount the broad social, including moral, values and imperatives. Despite a number of indefinite or unstable factors, many analysts would rely too heavily upon mathematical formulas for evaluation. They would also, in spite of doubtful reality and applicability, give undue weight to classical market-place economic analyses which feature the efficient use of capital, as suited to private enterprises, rather than the efficient use of resources, as suited to public projects and programs. Some would argue, further, that water is entitled to no special status or consideration -- in spite of its basic place in the economy and society -- and that it should compete for investment funds with all other desires. There is also opposition to allowances in evaluation for intangible benefits in resource development projects. And there is the general effort to restrict federal development and activity, already referred to.

Since the issues involve life, health, productivity, society and posterity, it should be clear that the intangible and imponderable benefits and costs involved in water supply development should have full recognition in evaluation. Broad studies of water resources development have recognized this; for example, the Water Resources Policy Commission said that "many projects will have their major effect on the broad development of our social economy. It will, therefore, be contrary to the public interest to place principal reliance on primary benefits which may often be private in character." 1/

One suggested approach to justification of water supply and pollution control -- one which might be either primary or ancillary -- is that of determination of a public convenience and necessity, of acceptance by government of a "public utility" responsibility in the public interests of health, welfare, and service. Certain necessary basic services in the economy -- such as transport, electricity, and water -- are commonly recognized as natural monopolies, not generally subject to the competition of the market place but subject to public provision or regulation. Often these must be provided, to meet requirements of public welfare and service and to undergird economic and social growth and advancement. In this case the real tests are those of meeting the acknowledged need with maximum effectiveness and economy, rather than those of high benefit-cost ratio or high rate of return on investment.

The problems of realistic evaluation of water supply developments -- in themselves or within larger multiple-purpose water development programs -- suggest a desirable area for socio-economic study.

Principles should be further evolved under which water will be available at the lowest feasible cost and for widest feasible distribution in harmony with the ability to use the water beneficially and economically. Such an aim is desirable in the interest of

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1/ President's Water Resources Policy Commission, op. cit.

optimum use of water supply as a basic factor in economic and cultural growth and advancement. It will be desirable to couple with such a developmental policy a conservation proviso including suitable incentives to economical use, salvage and re-use -- and, conversely, deterrents to waste -- of water supplies. Further study of means to this end -- including technical and financial aids, regulation, etc. -- is desirable.

As a conservational and economic principle, pollution should be abated before the fact, or as near to the source -- in home, community, industry, watershed, or river basin -- as may be possible.

Administration, organization and procedure for water supply and related research and development -- including federal, state and local, interagency and intergovernmental arrangements -- should be adapted to water management and control on a coordinated basis, and in the case of river-system developments, within a scheme of interagency organization for river basin development.

All of the principles sketched will have some effect upon the goals and patterns of research and will offer opportunities for useful social-science study.

The physical characteristics of development will also have a material bearing on the desirable patterns of socio-economic research. In this connection we might note and anticipate such conditions as these:

1. The increasing development of storage and regulation -- main control systems -- in river basins for water supply and pollution control and other multiple purposes.

2. The increasing improvement and more intensive management of small watersheds for water supply and quality control, along with the more conventional activities relating to soil and moisture conservation, erosion and siltation control, and crop, range and forest production.

3. Changed and new patterns of physical development of water supply, waste disposal, sewerage, and drainage -- increasingly in the pattern of systems designed and integrated on drainage basin and metropolitan area lines.

The probable trends in development of water supply and sanitary systems, together with trends in population and industrial concentration, suggest the need of research in state and local organizational patterns -- including water supply and sanitation districts in themselves or coupled with multiple-purpose improvement or conservancy districts, metropolitan governments or federations, or other coordinating devices.

CONCLUSIONS: A SUGGESTED OUTLINE OF SOCIALLY DESIRABLE RESEARCH

Broad appraisal of the state of research in the whole field of water supply would be desirable in the interest of filling deficiencies and gaps in the knowledge pertinent to the making of good plans and decisions.

A very wide range of interrelated social research is seen as desirable for the effective accomplishment of water supply and pollution control purposes in the region. From the societal point of view much more knowledge of man-and-environment problems should be accumulated and put to use.

To a large extent the water supply and quality-management research should be integrated in the larger scheme of comprehensive river-basin and regional planning and development.

In view of the basic social purposes the research in water-supply fields should have a strong social-science orientation.

In the interest of depth and breadth of knowledge and judgment the total research pattern should have a strong interdisciplinary cast. Strongly involved in the over-all research scheme, obviously, are such natural sciences as physical geography, geology, hydrology, biology, ecology, and the applied sciences of engineering. The desired knowledge, insights, and motivation for study and planning will be incomplete without application, individually and as a unified whole, of the social sciences -- including economic and cultural geography, anthropology, psychology, economics, political science, behavioral science, and the applied sciences of public health, administration and government. For coherence and wholeness in the research and planning, the generalizing disciplines of geography, of regional science, and of planning should be drawn upon.

The physical aspects of a well-rounded program have been widely considered and are not gone into here, other than to suggest a strong orientation to the chemical, biological (including genetic), and ecological implications of modern chemical and radioactive pollution.

A very extended view of the developmental and operational technology of water development -- including water supply and pollution control -- was provided by Ackerman and Löf a few years ago. 1/

Another broad view of research needs, primarily from an economics standpoint, has been presented by Allen Kneese. 2/ In his study, Mr. Kneese visualized the primary social-science research role in the formulation and pursuit of objectives and the physical-science role in the economic achievement of those objectives. The study did not seek to confront "the range of relevant problems of an institutional and administrative character." In behalf of broad physical and economic research, Mr. Kneese said that "any effort to establish efficient water supply and waste disposal is bound to be beset by a host of information and deficiencies, which cut across the boundaries of a variety of traditional disciplines." He suggested "a number of lines of investigation ... which should help to pinpoint the costs of pollution and enhance methodology and knowledge of scientific relationships critical for dealing with present and emerging waste-disposal problems in a socially meaningful and economically efficient manner." The lines of investigation proposed relate to basic data on wastes, methodology for keeping track of wastes, cost analyses, prediction of pollution loadings, and techniques for approximating optimum multipurpose and multi-unit system designs. Outlined were research needs, in social science and sanitary engineering, with respect to industrial pollution, sewage and water treatment, municipal water supplies, fisheries, agriculture, and alternative water quality control measures.

The Senate Select Committee report, with its very full coverage, provides excellent base, take-off, and guide for the planning and design of programs and projects for physical, economic and social research in this field. 3/

Here in this paper the major effort is to picture lines of research having to do with the broad socio-politico-economic

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1/ Edward A. Ackerman and George O. G. Löf, Technology and American Water Development, 1959.

2/ Allen V. Kneese, Water Pollution, Economic Aspects and Research Needs, Resources for the Future, Inc., 1962.

3/ Senate Select Committee, Report, and Committee Prints, op. cit.

conditions and consequences of water supply and pollution control in the wider framework of resources and regional conservation and development and of social welfare. For example, we are deeply concerned here with research that will throw light on the effects of high -- and low -- quality water on environment and society, on social tolerances in this connection, and on socio-economic results in the stability and movement of industry and people and the effective use of resources.

Recapitulating this view of desirable research, a suggestive summary outline of research fields and topics follows:

I. The anatomy of the total physical and societal problem of waste disposal and of water, land, and air contamination, and the total approach to solution.

II. The socio-economic base and setting for research, planning and development in the water supply and pollution control field.

A. Relevant conditions and trends in the economy and environment. For example: Demographic, economic and physical change and development. Biotic and ecological change and development. The biotic and economic community; the whole environment. The society -- its background, nature, knowledge, attitudes, motivation, etc.

B. The impacts of water supply, water quality, and pollution on community, society, posterity -- as on land use, population, and land occupancy patterns, urban and industrial development, on the migration of people and industry, etc. The special problem of persistent and cumulative pollution. Directions for industrial, private and public research and planning.

C. The general social and economic values, benefits and costs, and justification of water supply and pollution control.

D. Socio-economic research and influences in programs of field and laboratory research and demonstration in water supply and pollution control fields.

III. The social and economic necessities, goals and principles of water supply and pollution control.

A. Over-all environmental, needs and goals (space, resources, balance, stability, health, livability, etc.)

B. Economic needs and goals (productivity, economic, opportunity, health, income, etc.)

C. Social needs and goals (general welfare, health, education, recreation, amenity, etc.)

D. Political needs and goals (ethics, order, policy, law, administration, government, control, regulation, cooperation, etc.)

(1) Public policy in water supply and pollution control.

(a) Conservation of resources.

(b) Controls and incentives in interest of economical and wise use.

(c) Assurance of water supplies -- adequacy in quantity and quality, distribution, cost, etc.

(2) Legislative provisions and needs.

IV. The place and relationships of water supply and pollution control in comprehensive multiple-purpose river-basin and regional planning and development.

A. Goals, principles, criteria and standards for water supply development in the general plan.

B. Watershed management for multiple purposes, including water quality control.

C. Underground water storage and supply.

D. Water supply and pollution control in river system and basin.

(1) Role in main control system -- dams and reservoirs, control works, storage, flow regulation, etc.

(2) Common problems and requirements, interactions and reciprocal effects of water supply, pollution, sanitation, etc., with other of multiple uses of water and related land, for example --

(a) Waste dilution, aeration and purification in works and channels, with dams, power plants, reservoirs and channels.

(b) Pollution and siltation and siltation control, etc., with watershed management and small control works.

(c) Sanitation, wastes, water quality, etc., with recreational water uses and facilities.

(d) Water flow and quality, with fish and wildlife conservation.

(e) Water supply and sanitation, with irrigation and drainage.

(f) And like effects.

E. Benefits and costs evaluation, and allocation of costs, including those of multiple-purpose storage.

F. Economic and social justification of water supply and pollution control aims and programs in the general scheme. Productivity and income effects. Costs under alternative means. Environmental protection. Health and welfare. Public necessity and public utility. Relative values.

V. Industry roles and relationships in solution of problems of waste reduction and disposal.

VI. The role of educational and research systems and institutions.

VII. Governmental roles, organization, and procedure.

A. General responsibilities of government -- welfare, security, commerce, property; public utility; etc.

B. Governmental organization, missions and cooperation in the accomplishment of adequate water supply and pollution control.

(1) Federal responsibilities and leadership, and agency, interagency and intergovernmental action and cooperation.

(2) State responsibilities, organization and procedures. Including those for patterns of local government, and aids to local government.

(3) Local government responsibilities, organization, action and cooperation.

(a) Counties.

(b) Cities.

(c) Improvement and service districts --

Water supply and sewerage; sanitary.

Conservancy.

Multiple-purpose or consolidated.

(d) Coordinate planning and action in watersheds, drainage areas, metropolitan areas, through --

Zoning.

Annexation.

Consolidation, metropolitan government.

Federation.

Contract.

C. Education, training, and information aspects.

VIII. Over-all objectives and potentialities of joint industry, education, and governmental policies, plans and programs.

In closing, it is desirable again to stress the wholeness of the problem and the need, as well as of the pertinent knowledge and disciplines, and of the approach to solution, in a whole environment. It is also desirable to reiterate a purpose and hope for widest consideration -- by the public, and by the many industrial, educational and governmental institutions concerned -- of the full range of physical and social problems and means of solution in a comprehensive, well-balanced and coordinated program of action.

DISCUSSION

Q. How can a social goal be used in the evaluation of a water project?

A. Perhaps we shouldn't try too hard to reduce a social goal to monetary terms. The basic term should suffice to a greater extent and among more people - reviewers and legislators - than it does. They probably should lean less on the cost-benefit ratio and a little more on the absolute necessities of health and welfare. If you can evaluate them, that is fine, but it might be fruitless if carried too far.

A. I believe we have some experience in doing this. For example, consider the problem of recreation and fish and wildlife in terms of reservoirs. There is certainly a great demand in our American society for the utilization of reservoirs for recreation facilities and for fish. I don't suppose that anybody today would argue that a visitor's day value is adequate in order to arrive at some value for this social benefit. However, we have used it. We have arbitrarily decided on a value of $1.60 per visitor's day. Some justification can be found for this kind of value, but I suppose if anyone wanted to, he could question how we have arrived at it. This is one way we have attempted to force ourselves into a mold of a dollar value in terms of a social benefit. We might just as well say as a policy that recreation areas on reservoirs are good and that we will spend whatever money we need to develop these reservoirs to some satisfactory level so that people can use them. Thus, one way to approach a social benefit is through some sort of a pricing operation.

A. The alternative cost method might help. If you decided on an objective and had to accomplish it, the alternative cost of doing comes under consideration. Basically, once you determine the objective, you do it as cheaply and efficiently as possible. The determination of objectives is what is meant by the "social goal."

Q. I would like to see these objectives developed more on the basis of theory.

A. I would like to see the theory expanded too, but I would like to see it more pragmatic - more closely related to the objectives where it leads to planning and decision making. A good deal of this becomes so analytical, so theoretical, that only those who initiate it can understand it, and it isn't applied to problems.

We need to use more of the purposeful, pragmatic approach - cause and effect approach - in combination with the theoretical.

A. I have to work on practical problems and I have to compromise all the time with theory, and probably a little more compromise is desirable.

COMMENT: I might add that there are some interesting analogies in the field of city planning to this matter of establishing objectives. City planners might decide that there is need for so many acres of parking space per person in the community as indicated over a series of years by peoples' requirements and wishes. The result is an enormous investment in city parking because this is the sort of thing they feel they want to do to develop their resources. It might be less expensive to spend their money on parks or office buildings.

Q. I would like to raise the question of the desirability of quickly brushing aside the dollar value. It has more impact than we are inclined to believe and it is very definitely related to what we can expect our water consumption to be in the future. I cannot accept the very broad statements of people that our water consumption is going to double or triple in the near future. Consumption is predicated solely upon the gross cost of water and that means the cost of water to the consumer plus the cost of getting rid of that water and putting it back in condition to be used again. We are very frequently prone to neglect the cost of proper treatment. We in Seattle are face to face with that problem now. We know the cost of treating the used water is a major factor in reducing the amount of water consumed. Obviously there will be technological changes in industry as the cost of water goes up. I would like very much to find out more specifically the dollar value of these public uses, recreation, for instance.

Also I think there should be a little more clarification regarding terms we use, such as reservoirs. What type of reservoir do we refer to? People who have specific purposes in mind have a tendency to pick up these broad terms and then apply them to such purposes. My specific interest is in reservoirs for city water supply and the problems of utilization of such reservoirs for other purposes such as recreation. Most of the references in the previous discussions apply to multipurpose reservoirs.

A. I would like to refute the idea that the reservoir generalization is an over-generalization. I do not think it is becuase the quantities are getting so large that it's no longer economical to develop a reservoir without multipurpose uses. In other words, even in the Columbia, which is a rich water-supply region, storage requirements are reaching half the yield of the system. These cannot be single-purpose reservoirs.

A. We have to differentiate because we have several different types of watersheds and rivers. The Columbia River is a long river draining tremendous areas. In the Pacific Northwest we have many small, rapid, steep-sloped rivers with large quantities which are not at all comparable to the Columbia. Therefore, you must analyze the various aspects. You cannot be too broad in your generalities. Of course, we could use the general objectives in the analysis of such rivers as the Willamette and Upper Snake.

Q. What research is going on in the universities on social and economic aspects?

A. At Oregon State University there is at the present time a project on the economics of water pollution control. This is a study of the Newport-Toledo Bay area to identify the costs and benefits associated with water quality management. We also have underway a project in connection with the Oregon Game Commission to make an evaluation of the salmon and steelhead sports fishing in Oregon in an attempt to come to grips with the recreation problem. I was interested in the comments with respect to assigning dollar values to items which are very difficult to assign dollar values to in the absence of a market mechanism. I agree that in terms of the final decision perhaps more than simply dollar value should be taken into account, but I would add also that a careful determination of the dollar values can add immeasurably to the data and information available to the ultimate decision maker, whoever he may be. We need to recognize the limitations of our methods and we also need to recognize that even if our methods were perfect, there would also be additional information we would want to take into account.

COMMENT: I am a student at the University of California and, as a thesis, will be working on the incidence of benefits and costs relating to water quality management. This is actually a specific economic and engineering model for pollution control with reference to domestic wastes, which account for some 40 to 50 per cent of the pollution load.

COMMENT: A project is being conducted jointly by the School of Law, the Department of Economics, and the College of Fisheries at the University of Washington to study the biological, legal and economic aspects of limiting entry into a salmon fishery in Puget Sound. We are assimilating with high-speed digital computers data regarding the fishery in all its economic and biological aspects. In this way we can look at the various mixtures of different kinds of economic return, different kinds of participation, and form a judgment as to legal needs. This is probably the first attempt to use industrial dynamics and principles which have had quite a bit of study in other fields, into a problem that involves biology or into the use of a natural resource.

COMMENT: Dollars and cents are very important and everyone is concerned with money, but I would like to give one example of one poor country which hasn't a fraction of the wealth we have in this country and yet has risen above the question of money. That is Sweden. For example, Sweden has many beautiful valleys which have intrinsic value beyond the valleys themselves. Power lines are strung not the shortest way through the center of the valleys, but around the sides, even though it costs more. Why with water, the intrinsic value being in good water, do we by law have to think of dollars and cents?

COMMENT: Probably one of the saving features of benefit-cost ratio is that dollar values are applied to a physical thing which in many cases is constant while the values themselves are transitory. As we move into the future, one of the problems is an expanding population explosion - now if we don't solve the water problem, we won't have the explosion, at least not in this area. I'm wondering in the final analysis just how critical benefit-cost ratios are in making determinations on some of our construction projects.

COMMENT: One of the disadvantages of benefit-cost ratios, as they are practiced, is that people, when they get a figure down, seem to believe it. They think it's real - it has some meaning. We all know the tremendously unstable and indefinite quality of these factors. If we are to use them, we should do so with a great deal of common sense and perhaps give even a greater weight to the intangibles which are of more importance to public health and welfare. These are sure to override in the final decision.

ECONOMIC BASE SURVEY: A TOOL FOR RESOURCE MANAGEMENT

Myron Katz*

To accurately gauge the magnitude and character of future demands upon his resource is a major problem confronting the public administrator whose responsibility it is to manage a natural resource. In a dynamic economic environment it is manifestly difficult and, indeed, it can be ruinous to a resource for the resource planner to formulate policies, plans and programs based on the circumstances of the moment without at least faint attention to the breadth and character of future circumstances. For it is, after all, future circumstances which will control ultimate resource utilization and which, at the same time, will test the adequacy and appropriateness of the plans earlier formulated.

In resource management, what is past is prologue; often tragic prologue. For we have not always attended to the management of resources in ways which took adequately into account the role they would be expected to play beyond the moment. Lest this be construed as a harsh criticism of resources husbandry of the past, let me disabuse anyone so beguiled. It is an easy matter, with the benefit of hindsight, to be critical of the deficiencies of resource management of an earlier time. But it is not a simple matter to forecast scarcity amid abundance, to forecast market limitations due to supply at a time when market limitations are almost entirely a function of demand, to forecast even a few years ahead the exquisite meanderings of public taste, fashion and preference. But whereas in the past, because of the relative abundance of many of our resources, we have been able to avoid responsibility for forecasting future requirements upon our resources without incurring extreme penalties, as each year goes by we can less and less afford to indulge in such casual and cavalier disregard of the future and the penalties we will have to pay for taking the wrong path will become progressively more and more severe. We no longer have resources in limitless supply. The magnitude of supply is dwindling. The quality is deteriorating. Our population and per capita demands, on the other hand, are growing. If we could once afford not to exercise care in the preservation of resources from haphazard exploitation, we can no longer.

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*Economist, Bonneville Power Administration, Portland, Oregon.

In order to produce the optimum return to society, now and in the future, from the management of our resources, and thus minimize the progressively increasing penalties which will accrue from mismanagement, correct policies must be sought. Of course, resource policies, once adopted, need not be static and inflexible, incapable of adjustment and modification when unforeseen circumstances arise. But if they are to be meaningful and do the job for which they are intended, they must, like an organic document of law, be sufficiently durable to permit a body of subordinate law and public action to develop about them with assurance that they will not be abruptly altered at the slightest turn of events. How appropriate these policies are and how well suited to the needs of the present and the future will depend, in large measure, on the notions of the future upon which the policies are based.

A formidable responsibility is imposed upon the public administrator who is a resource manager. He is a trustee of the public's resources. He is required to exercise a type of fiduciary responsibility as conservator of that resource. He must manage the resource in a fashion which extracts from it the maximum cumulative return to society, today and tomorrow. Decisions on resources development made today will have profound and lasting consequences to both present and future generations. Faulty decisions, once made final, can be accompanied by irreparable damages. It is, therefore, imperative that decisions of such sweeping and, in many cases, irrevocable consequences be made with supreme care and with the long-range view of future generations in mind, lest we default on our obligations to posterity. Great care must be exercised to assure that resources will be utilized intelligently in the face of irreversible encroachments of civilization and technology.

Let me cite three illustrations. For example, construction of a hydroelectric facility changes the character of the site itself and, very often, the surrounding countryside and water course for miles around. Once the project is constructed, however, it is invariably too late to redress mistakes. A power plant which meets today's demands for hydroelectricity may have been the wrong plant at the wrong site to adequately meet tomorrow's demands. It may pre-empt and foreclose use of a superior adjoining site better suited to satisfy future hydroelectric demand. Worse yet, a power plant which meets today's demands for hydroelectricity may destroy or impinge upon a conflicting resource the demand for which, in a more technically advanced and less benighted future age, far outstrips the future demand for hydroelectricity.

As another illustration, today the highest and best use of a given stand of timber may be for the production of lumber, plywood, pulp or some other forest product. Tomorrow, by virtue of shifts in public preference and changing technology, the highest and best use of that same timber stand may be for recreationists to stand and stare at an unmodified chunk of nature's handiwork. But if the timber stand has been committed to its earlier highest and best use and harvested in the interim, its potential as a recreation resource may be so seriously impaired, even after regrowth, as to disqualify it for its subsequent higher and better use.

Finally, the highest and best use of a given water resource today may be to carry away pollution. Tomorrow that same water resource may be in far greater demand by industry for cooling, by households for domestic consumption, by recreationists for swimming, fishing, and boating. But if the commitment to its earlier use cannot easily be undone, as often it cannot, the water resource will be returning to society a fraction of what it could and should return.

The foregoing illustrations do not imply that dam construction, timber harvesting or using water to transport pollution are necessarily misuses of the public's resources. They do illustrate, however, the irrevocable nature of some of the decisions which public administrators and policy makers are required to render and the critical importance of forecasting with the highest possible degree of accuracy the future demands upon various resources. Not only are there penalties to society from faulty decisions resulting from inaccurate forecasts in the form of damage to resources, loss of industry, under-achievement in production possibilities and unsatisfaction of society's demands but there are also penalties which attach to over-investment, misplaced expenditure and idle capacity.

How is the future to be divined? What are the techniques available to the forecaster? What can be done to maximize accuracy? Let us attend now, by way of example, to the economic base survey, the function of which is to furnish the resource manager with a carefully and skillfully evolved notion of the future.

The example to which your attention is directed is the Bonneville Power Administration's Pacific Northwest Economic Base Study. For the purpose of long-range planning of electric power facilities in the Pacific Northwest region, BPA has embarked upon an intensive economic base survey of the region. The Pacific Northwest includes Washington, Oregon, Idaho and that portion of Montana west of the Continental Divide. The objective is to forecast the probable economic development of the region over the next 25 years in order to accurately project anticipated regional electric power requirements.

Using the BPA study as an illustration is not inappropriate. Development of natural resources to satisfy demands for power is not unlike development of other natural resources to satisfy demands for recreation, for domestic and industrial water, for the products of the forests, for food and fiber from the land, or for minerals from beneath the land. If there is any difference at all, it probably lies in the fact that load forecasting in the electric utility industry, in general, and at BPA, in particular, is well established as a basic ingredient of the management function. Forecasting is firmly established in the utility industry because of the long life of installations, the substantial lead time required for constructing facilities, the magnitude of the investments involved, and the responsibility inherent in furnishing reliable and adequate service to the public. These characteristics of the hydroelectric industry have long operated to confirm and reinforce the importance of long-term load forecasting. A comparable importance, however, is now being attached to forecasting in other natural resource fields as demand inexorably expands while supply either remains fixed, as in the case of land, diminishes in quality, as in the case of water, or contracts, as in the case of mineral reserves.

Because the BPA study is an on-going enterprise and one of rather ambitious dimensions, a description of its methodology and techniques serves as a convenient way to explain the nature and mechanics of the economic base survey.

In briefest terms, the purpose of the BPA study is to analyze the future industrial and economic capabilities of the region, the population which such capabilities will support and to forecast from this data the ultimate power requirements of the region - in five-year intervals to 1985 with a projection and exposition of trends to the year 2010. It is expected to take approximately four years to complete from the time of its inception. When completed, it will serve as the basis for future load forecasts, for long-range planning of the region's main grid transmission system, for rate structure review, and for identifying economic potentials of specific industries within the region.

The theory underlying the BPA survey is that regional electric power requirements are primarily a function of regional population, that population in turn is primarily a function of employment opportunities, and that employment opportunities in turn are primarily a function of the manpower requirements of basic or export-type industries. Thus, if the relationships between power requirements, population, employment and basic industry jobs can be forecast, it follows that power requirements can be forecast indirectly, by application of these relationships, from a forecast of basic industry employment.

The theory is not without its qualifications. Certain industries, for example, are consumers of enormous blocks of power and a forecast of expansion in any such industry would naturally indicate substantial increases in power requirements over and above increases which will result from population expansion and changes in per capita power consumption. Similarly, while future demand for water resources might also be a function of future population, there are some industries whose water requirements are unique or substantial and for whom special allowances must be made in forecasting the future regional demand upon that resource.

Early in the planning phases of the BPA study a list of the region's basic industries was prepared. Although there is no hard and fast definition of what is a basic industry and what is not, in general they are limited to the extractive and manufacturing industries - the mines, farms, forests and factories of the region. As a general rule, these are the industries which are responsive to and affected by changes in demand arising from outside the region. They include forest products, agriculture, food processing, minerals, chemicals, fisheries, defense and, although neither extractive nor manufacturing, recreation and tourism. These industries, and their many sub-classification components, were selected for intensive study and analysis.

In addition, certain key natural resources which will strongly influence the capacity of the Pacific Northwest region to support basic industries or to successfully compete with other regions for location of basic industries were also selected for intensive study. These include the fuel and energy sources available to the region and the water resource for direct industrial purposes and for generation of power. Having identified basic industries and the key natural resource factors which could act as limitations upon expansion of these basic industries, BPA was prepared to embark upon its economic base survey mission.

Most of the studies in the BPA base survey are to be performed by those government agencies and, where necessary, private consultants, who are acknowledged authorities in the field assigned them for study. Memoranda of understanding are executed between BPA and other federal agencies to do some of the work and contracts are executed between BPA and non-federal agencies and private consultants assigned other study responsibilities.

This technique of contracting out to others the responsibility for particular studies was adopted in order for BPA to obtain the services of experts and to enable BPA to draw upon a large store of background experience and information which the BPA staff would be unable to secure without incurring a substantial, albeit impermanent expansion in its size, with a concurrent waste of time and money.

At the same time that contractural arrangements were being concluded with respect to the study of basic industries and key resources, BPA also contracted for research into historical data on population, labor force and employment in the Pacific Northwest. The purpose of these employment studies is to provide an analysis of shifts in the employment pattern among industries in the region and among geographic sub-areas and thus to furnish information necessary for the study of the critical relationships between population, labor force and employment, which underlies the theory of the BPA study.

Finally, BPA initiated, again by contract with other agencies, research into personal income payments in the Pacific Northwest, by source of income on a county-by-county basis, to supplement, test and reinforce the data developed with respect to population, labor force and employment.

The first BPA economic base study contracts were executed with the bureaus of business research of the University of Washington, University of Oregon, University of Idaho, and Montana State University for the preparation of the studies on population, labor force and employment in each of the states within the region. These studies were prepared in cooperation with the four state departments of employment security.

The studies on personal income payments have been contracted to the state departments of planning and economic development in Washington, Oregon and Idaho and to Montana State University.

Forest products industries are being studied by the Pacific Northwest Forest and Range Experiment Station of the U. S. Forest Service; agriculture and food processing by the Economic Research Service of the U. S. Department of Agriculture; mineral industries, with the exception of aluminum, by the U. S. Bureau of Mines; freight rates by the General Services Administration; fisheries by the U. S. Bureau of Commercial Fisheries; quantity and quality of water by the U. S. Geological Survey; aluminum, petroleum, petrochemicals and natural gas by private consultants. The study of recreation and tourism is being conducted jointly by BPA staff and the Recreation Subcommittee of the Columbia Basin Inter-Agency Committee. The study of coal involves the joint participation of the U. S. Bureau of Mines and a private consultant.

Because the BPA study encompasses an entire region and its results will have a bearing upon the planning operations of other federal, state and local agencies and private institutions and organizations, an Economic Base Study Advisory Committee was established. At the inception of the study, the Secretary of the Interior appointed members to the Advisory Committee from among a broad-based representative group of agencies and institutions. The Advisory Committee is comprised of representatives of the Pacific Northwest governors, the state departments of planning and economic development, the bureaus of business research at universities in each of the four states in the region, industrial and utility customers of BPA, major federal resource agencies, other public agencies, new media aud trade associations. The Committee's membership possesses a recognizable competence with respect to Pacific Northwest development and is able to contribute valuable advice and assistance to BPA relative to the conduct of the economic base survey, its framework, scheduling and methodology. In addition, the Advisory Committee provides technical review of drafts of the various sections of the study as they are completed and submitted to BPA.

The functions to be performed by BPA staff economists in the conduct of the economic base survey are varied. With the advice and technical assistance of the Advisory Committee, the BPA staff developed the scope, methodology, and framework of the over-all study. In addition, the BPA staff is responsible for initial preparation of the outlines of the specific industry and resource studies. The staff also developed a set of common assumptions to be used by all participants in the study. These assumptions, made in consultation with other agencies performing base surveys and with the Resources Program Staff of the U. S. Department of the Interior, include projections of population, employment, gross national product, trends in technology, national policies on economic development and housing, cold-war status, international trade, and a series of special assumption projections with respect to electric power in the region.

Perhaps the most important function performed by the BPA staff is coordination and supervision of the specific industry and resource studies. This type of control is important because much of the information developed in the study of one industry or resource can have critical feed-back value to the study of another industry or resource. In addition, it is desired that a high level of comparability and compatibility be attained between the different studies being performed independently and simultaneously. As has been noted, the studies on employment and the studies on income are being done by different agencies in each of the four Pacific

Northwest states. In order for these studies to bear comparability with one another, the BPA staff has not only selected the procedures and methodology to be used but, upon completion, will amalgamate and synthesize the component studies from the different states into comprehensive and integrated studies for the entire region. The coordinator function, then, has been assumed by BPA, the sponsoring agency, with the advice and assistance of the Advisory Committee.

In addition, the BPA staff of economists has established and maintains close liaison with other agencies which have embarked upon economic studies of geographic areas which are common to the BPA study. Although the ultimate objectives of these agencies do not coincide strictly with the objectives of the BPA study, nevertheless, because similar data must be developed in each of the studies, a working liaison furnishes opportunities for each study to enhance the other. This liaison results in more than just exchanges of mutually useful information, important as that is. It has also resulted in development of key assumptions and, in some cases, procedures, which can be characteristics in common to all of the studies. This not only serves to minimize duplication of effort but will result in more uniform, consistent and compatible study conclusions to be achieved by the elimination of unnecessary discrepancies. The BPA staff feels that this effort to reduce or eliminate conflicts between the BPA study and the results of other base surveys which pertain to common geographic areas resolves questions and uncertainties which would otherwise inevitably obtain among prospective users of the studies. Not every reader, for example, is sophisticated in the whys and wherefores of economic base studies and cannot, therefore, be expected to attend carefully to every study qualitification and to technical differences in assumptions and scope.

As mentioned earlier, the end product of the BPA study will be the development of power requirement forecasts. These particular forecasts will be uniquely applicable to the development of the Bonneville Power Administration's program in the Pacific Northwest and to the effective execution of that program.

The comprehensive supporting data and forecasts of production, employment and population which will be developed along the way and upon which the BPA forecasts of power requirements will be based, will, however, have substantial usefulness to other agencies, particularly those charged with responsibility for management and planning in the natural resources field. Since these supporting data and forecasts will be developed on a sub-area as well as a region-wide basis, they can be converted by other agencies into forecasts of their own for a variety of natural resource requirements other than power. The BPA studies are being prepared, where possible, on a county-by-county basis or, where this is impractical, on a sub-area basis within the four states of the region. In this way a small common denominator for area information will be achieved. Resource agencies with larger jurisdictions will be able to aggregate these data to conveniently conform to their own requirements. In this way, BPA has sought to make its economic base survey of maximum usefulness.

I would like to allude to the disposition of an economic base survey once it is completed and published. The initial reception can be keen and widespread. The study will most certainly be used intensively by the agency responsible for its preparation. If the study contains data assembled in a way which maximizes its usefulness, other agencies will probably also use it with considerable satisfaction. As time passes, however, the economic base survey will lose some of its initial luster. Since the future cannot be forecast with perfect accuracy no matter how carefully the supporting data is prepared, no matter how elaborate the forecasting techniques used, and no matter how adequate the assumptions and the scope, the study will contain some forecasting errors and other misjudgments. These errors will become more noticeable with the passage of time. The temptation to relegate the study to history will become substantial.

It should be borne in mind, however, that a wrong forecast does not necessarily mean a bad forecast. If the forecast proves wrong for an identifiable reason - an assumption that turned out erroneous or an interpretation of data not warranted - it can be modified and adjusted and thereby retain its value and usefulness. If the comprehensive data supporting the forecasts is accurate, that data will remain useful even though the interpretation of its impact upon the future fell short of the mark.

There is, in other words, no reason to abandon a well conceived and well executed economic base survey at the first sign of obsolescence. Indeed, there is no need for obsolescence. The economic base study can and should remain a viable tool for the resource planner. Viability can be infused into base studies if, from the moment of their completion, they are subjected to periodic review and updating. From the time of publication forward, the base studies should undergo a continuous process of evaluation and re-evaluation. No matter how elaborate and persuasive a study is, it should not be accepted uncritically. The process of criticism, of evaluation and re-evaluation, should be thorough, penetrating and continuing in order to extract from the surveys their maximum potential contribution to resource planning.

If necessary, an economic base survey should, after a suitable passage of time, be revised and republished. It should not be allowed to fall into disrepair and disuse. If neglected, not only would the return on its initial investment be sharply limited at a level substantially below the return potentially attainable, but the opportunity to profit from mistakes or misinterpretations, to compensate by modification and correction for misjudgments, would be seriously impaired.

The expenditures involved in continuously maintaining and updating an economic base survey are pale in comparison to the enormous costs attendent to faulty resource policy decisions. Indeed, so much is at stake and the penalties which must be paid for making wrong decisions are so high that continuous surveillance of an economic base survey after completion is probably the only inexpensive way to minimize the risks involved in the formulation of policy where a wrong decision, once adopted, can never be changed and where the consequences of wrong decisions are extreme both in amplitude and duration.

With this stark and awesome specter confronting the resource planner, it behooves him to base his decisions upon the best information and forecasts available at the time decisions must be made. The way to reduce risks is to make certain that the decision maker has access to current information and as accurate forecasts as possible of the characteristics of future economic influences which will affect his resource.

No one doubts the relevance of economics to the effective utilization of resources. As crises in resource management become more and more frequent and severe with expectations that the crush of steadily mounting demand will soon reach staggering proportions in the face of rigid limitations on supply, the need to develop economic base surveys and their accompanying forecasts intensifies. The resource planner is compelled to take more seriously the demands of the future. In a less demanding age, perhaps he could more easily afford to substitute his own intuition for economic analysis. The crises in natural resource management no longer permit indulgence in this easy luxury. The economic base survey, for better or for worse, furnishes an important tool for decision making. The quality of the decisions made are more and more dependent upon the quality of economic forecasts. The role of the economist seems firmly established. It is his responsibility to furnish the best analysis and assessment of the future. It is the planner's responsibility to incorporate this assessment of the future into the complex of factor-ingredients he must rely upon in making his far-reaching decisions.

DISCUSSION OF PAPER PRESENTED BY MYRON KATZ

John H. Davidson*

It is difficult for me to inject a note of controversy into my discussion of the paper by Mike Katz because I happen to agree with most of the points which he presented. There were some items, however, which I want to comment on and which I anticipate will provoke discussion from the floor. For the purposes of my discussion, I will cover three areas: first, a listing of some of the items from Mr. Katz' paper which might benefit from the expression of other viewpoints; second, a brief description of how economic base studies relate to our water supply and water quality management program; and third, some comments on research needs and development of methodology that are now being considered by the Public Health Service.

Among the items which I anticipate will be discussed in more detail from the floor is whether or not there is an advantage to erring on the high side when making a forecast. An important consideration in such a decision, of course, is the nature of the plan we are making. If we are concerned with irreplaceable resources we need to be particularly careful. Mr. Katz gave several examples to illustrate this point. It is useful to keep in mind the point that even if the forecasted demand for a resource is too high for a given study period, it will probably only be a matter of time until the demand is reached. There can be an undue penalty to the users of the resource, however, if the time is off too far.

Related to this item is the question of how much concern we should have for the future and how far into the future we should look. As Miner Baker, from Seattle, has pointed out in other meetings, the average per capita income is expected to increase a considerable amount each decade in the future. I have heard it questioned why the present relatively poor generations should worry so much about their wealthy descendents. Of critical importance in such a question is again the consideration of whether the resources involved are irreplaceable. We must also keep in mind, however, the fact that new processes or needs sometimes make useless materials valuable and vice versa.

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*Chief, Economic Studies, Water Supply and Pollution Control Program, Pacific Northwest, Public Health Service, Portland, Oregon.

I also hope there will be some discussion about the method of making economic base studies that was described by Mr. Katz. Although the industry-by-industry approach which he described is certainly a valuable tool, its shortcomings should be considered when the results of such a study are translated into plans. One of these shortcomings is that such industrial forecasts are mainly derived from considerations of what industry could produce rather than consideration of the pattern industry might or must take to meet employment demands as well as consumer demands of future populations. The consideration of this factor indicates the need to recognize categories of employment which might have a different basis than any we might now recognize. This suggests that an industry-by-industry study needs to have a large allowance for the unknown.

I have a further comment about industry-by-industry studies, and I believe that this applies to the one Mike described. In seeking to derive the contribution of an industry to the economy, the device of dividing all industry and employment activities into two categories as basic and non-basic, or primary and secondary, is frequently done. This appears to be an oversimplification which can lead to considerable error, not only in understanding the present but also in forecasting the future. I will discuss this further in the third part of my discussion concerning research needs.

There are also other means of making such studies. There is what we call a bottom-up study. We also use a top-down method.

As my second area of discussion, I would like to describe, briefly, the relationship of such economic base studies as Mr. Katz described, to our own program for water supply and water quality management. One of the needs for such a study is fairly obvious - we need to know the possible future dimensions of the need for the water we are concerned with. These dimensions include the size of both population and industry, their quality and quantity requirements for water, and their pollution contributions. The water requirement considerations must include not only water supply and other withdrawal uses, but also the multitude of in-place uses for water. The economic base study translated into water quantity and quality requirements is the starting point for the engineering calculations which will provide the plans for various physical structures and water management programs to serve population and industry.

This introduces another use of the economic base study. When the engineering calculations are completed and the costs of providing for water supply and water quality management programs are estimated, the economic base study is then used as the basis for deriving dimensions to the benefits which might accrue to such programs. Benefit evaluation, however, is another subject and will be introduced later in today's program.

A comprehensive economic base study is important both directly and indirectly to water resource quality control programs. The two aspects I just described were directly related. Of equal importance, however, is the indirect aspect involving providing the dimensions of the other factors which will need to be available along with water. Power, for example, also needs to be provided for population and industry, and if it is not available, the requirements for water might be changed. The preparation of an economic base study is thus a powerful force for coordinating the various components of an area's resource development. Of particular importance in this regard is the relationship of land to the other resources. Planning for water and electricity for industry, for instance, will be fruitless if an adequate supply of land of suitable character is not available. The providing of land through zoning or other devices is particularly important because it is so difficult to find economical substitutes for space.

I will conclude my discussion with some comments on research needs relating to economic base studies and their application. These are not listed in order of importance.

The translation of economic base information to withdrawal water use and to contributions to pollution is a problem that is particularly important because of the effect research in this area could have on the complexity of the economic base study. We know, for example, that there is generally a higher per capita water consumption in areas of higher income. To take advantage of this knowledge when we are forecasting water requirements would require an estimate of relative income levels. Other economic factors also affect water consumption. I feel that there is a considerable field for research in understanding the water use and pollution generation factors for various sectors of the economy. Such research should include not only consideration of economic variables but also regional differences.

Another area of research which I know a number of economists are concerned with is the question of what happens to old economic base studies. I think it would be rewarding to take some of the studies of a few years ago and compare them with what actually happened. Not only could this help us understand the nature of our forecasting errors, but it could indicate the consequences of such errors. One of the "308" reports, I remember, had a forecast of seven rayon plants in the Pacific Northwest. I imagine this helped justify certain electric power facilities. Although these rayon plants were never built, the area has prospered and we have continued to utilize all our available power facilities.

The methodology of economic base studies is another area for study. As I mentioned earlier, I felt that it was an over-simplification to class industry into such categories as basic and non-basic, or primary and service. On the other hand, an input-output study describing inter-industry relationships is not feasible for many small areas and data are lacking even for most states. A concept that we are trying, and one that we would welcome more research into, is to classify each industry into two components: an externally-oriented component and an internally-oriented component. Such a device recognizes the fact that even a so-called basin industry frequently serves the local population. On the other hand, many of the service industries serve remote areas and are thus partly of a basic or primary nature. Forest products, for example, are considerably used in our region and in the communities where they are produced. The medical industry, on the other hand, in Portland serves to some extent both southern and eastern Oregon.

The problem in utilizing this concept is to find a reasonable way to divide any given industry into these two components. A very simple way which we are exploring is to compare the study area to the nation in terms of average employment in each industrial category per 1000 persons of population. Although this is also over-simplified, it does provide some insight into the relative importance of the two components. As you can see, this procedure is really an input-output study of the simplest sort with the inter-industry relationship described in terms of employment and aggregated into just two components.

By way of concluding my discussion, I want to bring to your attention again the comments Mr. Katz made concerning interagency cooperation and the importance of making studies useful for all. In this regard it should be pointed out that the Columbia Basin Inter-Agency Committee has recently appointed a subcommittee on economic studies which will, as a first task, inventory economic base studies now underway in the Northwest. I would like to introduce Mrs. Remak of the Oregon State Department of Planning and Development, and Chairman of the Subcommittee on Economic Studies, who will describe how we can all participate in the inventory.

DISCUSSION

COMMENT: The Oregon Planning & Development Commission, 1400 S. W. Fifth Avenue, Portland, has initiated a project which involves a continuing record of economic studies, reports, and research being undertaken by public and private agencies in the Northwest. This will constitute a clearing house for this information so that those in the field will know what others are doing. A report is in process and will be available on request.

Q. I suspect that the Public Health Service comprehensive water quality control efforts will give rise to a great number of economic base studies. In most of these the manufacturing sectors are going to play a considerable role, being a generator of basic income. Are there underway general location studies for the United States as a whole which would indicate what the emerging patterns are and what comparative advantages there are in various regions? It is possible, for example, by casual observation, that certain industries depending more and more on foreign raw materials are moving toward tidewater. Certain of the so-called "foot-loose industries" are searching for locations close to a good university. How much information is there on these over-all patterns that certainly have to enter into a forecast for a particular region? This is an area that might be very fruitful of research in view of the greater interest in economic base studies.

A. There is a need for more studies of this nature. The Bonneville Power Administration study will be extremely useful because it is of more than a regional nature. They are looking at the national situation. An industry-to-industry study, based on what can be seen in an area now, is short-sighted. One must seek to at least allow for the unknown things such as the attractiveness of amenities, the importance of deep-draft transportation. The Bonneville economic base study has this in mind because each of the basic industries studied goes beyond the Northwest insofar as potential markets are concerned. We are concerned with our competitive position as it may relate to a particular industry five, ten or twenty-five years hence, and we should not be restricted to the four or five states which Bonneville is directly serving, but also should be concerned with respect to the products which we have to export. The Southeast Study Commission, which has just completed plans for the Southeast basins, also uses this approach in that they are not only studying the potential of the industries within that region, but nationally.

Q. Does the Bonneville study go into the matter of resource use, factors in industrial location, and factors in community development?

A. The Bonneville study is concerned with the factors of industrial location - the factors which underline industrial location decisions. It is difficult to figure out on a current basis what now motivates industry to locate in one place rather than another. To forecast into the future compounds the difficulty. The study of water quality and quantity is designed to measure the capabilities of the water resources of the Pacific Northwest to support various types of industrial activity, but involved isn't just the capabilities of this region for industrial activity or development but also the limitation of such resources elsewhere in the United States which would tend to act as a stimulation to location here by virtue of water deficiencies elsewhere. The study, therefore, must be more than region-wide, it must be national in character. The Northwest will be the beneficiary of critical water shortages elsewhere. In order to be the full beneficiary of those deficiencies, we have to study where these deficiencies are elsewhere and preserve our own resources.

Q. Will the Bonneville report estimate not only what future growth might take place but what growth ought to take place?

A. This will be left entirely to the resource manager since we have no special competence in that field. We are trying to forecast what will happen - not what should happen.

Q. I am puzzled how an economist has any feeling of confidence in this type of forecast when it must surely be affected by external political actions. For instance, if Britain enters the Common Market, it may realign Canada's effect on our forest industry; British Columbia's internal politics may affect our hydroelectric power. Even our own political climate may have an effect.

A. Forecasts are not made with great confidence. This is one of the reasons why an economic forecast once made should not be left unattended. It should not be assumed that the figures are right and just because there is a number you are equipped and armed with a definitive answer. We have concocted a series of assumptions. Assumptions on international trade, for example, are that there will be a gradual relaxation of trade barriers between countries between now and 1985. By 1985 trade barriers will be substantially reduced, if not altogether eliminated. It is assumed also that between 1985 and 2010 there will be some substantial changes in international political complications so that in the Pacific Northwest region, which has direct ocean access to trans-Pacific hemispheres wherein reside the world's overwhelmingly large population and a potential consumer market of extraordinary dimensions, those political factors will also become subdued. One must go along making some assumptions and making sure that once the study is done any change which indicates an assumption was in error is appropriately incorporated into a modification of the result.

Q. Will there be any allowance for alternatives in the conclusions now?

A. There will not be many alternatives indicated since that involves ranges, and ranges can be added on to ranges. It is much better to say, "On our best judgment, the most probable, the most achievable dimension of economic development is such and such in terms of employment or gross regional products, etc."

Q. Is intuition used in reaching the assumptions? You have a statement here to the effect that perhaps a planner could more easily afford to substitute his intuition for economic analysis. It seems that those assumptions are merely intuition.

A. The assumptions are controlling, but they are qualified accordingly. This forecasting is not based on intuition. Assumptions are made which are defensible, which are reasonable, and which might or might not obtain or control. The resource planner uses factors other than economic analysis and it isn't any more intuition than assumptions are. He uses a determination of policy, determination of sound practices toward resource use. This report is simply a tool in helping him to make a good decision.

Q. There seems to be an inconsistency here. You stated that an economic base study should not grow old but should be kept up to date. When you approach this problem industry by industry and do not carefully recognize interrelationships among or within industries and guess wrong in a specific industry, you run into extreme difficulty in making the change in the over-all economic projection.

For instance, if the aluminum industry does come in or does not come, this is not the only industry that's affected. All the other industries will in their own way be related. What do you visualize as a continuing effort of how in the future you will attempt to modify your initial projections as some of these things do not come to pass? Would you agree that there is a basic need for research effort here in some of the methodology of forecasting?

A. It may very well be that the methodology incorporated in the Bonneville study is not the appropriate one, but even if the methodology is inappropriate and a more suitable methodology is developed, the basic data which is assembled is of a voluminous character and should be extremely useful to a modified methodology.

COMMENT: A fairly recent study made by Stanford Research Corporation in California did help to reduce a good deal of this forecasting through equations or formula so that it is possible to go through and, if they made a wrong assumption, to substitute a somewhat different value and come out with a different answer until the relationships get completely out of date.

COMMENT: There have been soothsayers who have made this kind of prediction on as poor a basis, but it gets better every time. The most important thing to avoid is gross error. If you determine the main growth in breadth, you come out pretty well. You don't have to undo anything - growth takes care of it. The error, whether you get aluminum or titanium or anything else, becomes irrelevant. You adjust to it as long as you have that main direction and provide for enough growth for the next generation.

COMMENT: It seems that the question of varying on the high side is left up to the resource manager. The forecast projects what is most likely and follows this with a series of alternatives. If we wish more power, we give up that much recreation, or the resource manager may decide that in his judgment it's worthwhile to forego a little power to take care of a little more recreation. If you are confronted with a choice conflict, to choose one or another, and it looks as though the odds are even, it is probably wise to resolve that conflict in favor of the high side rather than the low side. All other things equal, you will be taking less risk and the penalties would be minimized.

Q. There's a temptation to allow an X-factor so that there will be a little extra. This is in favor of erring on the high side. Is this not deliberately interjecting into the study errors on the high side?

A. Errors should not deliverately be introduced into a forecast.

COMMENT: The non-economists are often concerned with the matter of whether or not the economists will provide the numbers which are fundamental in the planning process and from that translate all material into end results, because they have control over the forecasting technique. In the Portland office of the Public Health Service we have attempted to understand better the use of economic forecasting in the development of a regional plan for water quality management. The Public Health Service, not only here, but also in other parts of the country, is throwing a great deal of effort and resources into the development of forecasting as a means of trying to establish a quality management plan. There is a paper which has not been published, but is merely a staff paper with some distribution in this region, entitled "A Proposed Method for River Basin Analysis for Water Pollution Control with Special Reference to Low Flow Augmentation." The purpose of this paper was to identify and analyze the normal and presently-used methods of economic analysis in long-range planning and then to suggest a more rational set of elements which are subject to more rational decisions. This provides another method for making an analysis which will use the economic base study but not fully and totally depend on that study.

The next step in the development has been to undertake a programming effort using computers. Once that programming effort is completed it may provide a more simplified way to utilize economic base studies in water quality control planning. For this purpose there are available elements that can be controlled like the determination of treatment requirements, like quality standards in a stream, like an assessment of the top-level resources. These provide definite numbers of pollutional inputs that are potential to the system. In this way sole dependency is not placed upon the numbers which the economists in their forecasting devices provide.

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT

Allen V. Kneese*

More and more it is recognized that pollution is a problem which, in most respects, can be best analyzed and dealt with on a regional basis. 1/ This is seen in the recent creation of the Delaware River Basin Commission, a major function of which will be the management of water quality, and the USPHS Comprehensive Planning Studies for the various river basins. One might hazard the forecast that in future years, with growth in industry and population, water quality problems will furnish a far stronger impetus for regional water management than will problems associated with the quantitative depletion of water in most areas of our country.

In order to suggest a number of general things which economic analysis may have to say about regional water quality management, I will assume that a regional authority exists which is capable of implementing measures which appear economically efficient, if it so desires. Also I will assume that water laws in no way inhibit efficient behavior. These assumptions are made to avoid spending much time speaking about institutional arrangements for water quality planning and management. Also, since it has been extensively discussed in another session, I will say very little about the very important matter of making regional economic projections. In addition, at least in the first part of the paper, I will be much more concerned with principles rather than practical applications. One final preliminary warning, if at times despite my efforts to stick to matters of economic efficiency I encroach upon the topics of previous or subsequent speakers, I hope the audience will attribute it to the nature of the subject matter.

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*Resources for the Future, Inc. The views expressed are those of the author and not necessarily of his organization.

1/ This generalization does not hold completely, of course. An interesting exception is illustrated by the recent German detergents legislation. Regional methods of handling the problem were explicitly analyzed and weighed against the cost of a national measure to outlaw the sale of hard detergents. The latter was judged the superior alternative.

I will begin my presentation by indicating briefly how pollution gives rise to costs which are not reflected in private calculations and by pointing in a general way to the implication this has for the most efficient allocation of society's resources. Then I will describe how the matter of designing a regional waste disposal system arises as a problem in addition to that of rectifying the distribution of social costs. In my view these are the two basic economic issues which a regional authority would face with respect to the pollution problem.

Let me indicate them once more. (1) Approximating an optimal system for the disposal of the region's wastes, and (2) Distributing the costs inevitably associated with waste disposal in an optimal way.

A major point of my presentation is that these two problems, while distinguishable, are strongly interrelated.

In the U.S. we generally depend upon the market place to guide production in such a way that consumer demand is satisfied as well as possible, given the limited amount of resources at the disposal of society. I think it is the concensus of most economists and other economically informed persons that this process works quite well for most goods and services. However, it is possible to identify instances in which the individual decision making units of our decentralized society fail to make decisions which lead toward maximizing the value of production to consumers. This is because under some conditions they have no incentive to include the full ramifications of their decisions in their calculations or perhaps even to find out what the full results are.

One of the basic conditions for satisfactory social results from the decisions made in the market place is that the technical conditions of production and consumption be such that the costs and benefits of performing a given act fall upon and accrue to the economic unit which performs it. While this condition is usually fulfilled in the production of goods and services, it frequently is not met in private water resources development and its lack of fulfillment, in regard to waste disposal, might be called the essence of the pollution problem.

If some costs can be shifted to other economic units, the private costs incurred by a particular economic unit do not correspond to the full cost to society. Consequently, resource allocation is distorted even though markets function in an otherwise satisfactory fashion. Let me illustrate with an example not connected with water resources. If the employment of a mother results in the delinquency of her children, private costs of the employer (i.e., the wages) do not equal social costs. The latter may include such things as property damages, extra police, etc. Economists often call indirect effects of this kind "spillover" or "external" effects.

Water pollution, together with smoke nuisances and damages, are, as many of you know, the economist's classic examples of such "spillover" effects. Where "spillover" damages due to water pollution are significantly large, the general type of distortions which occur can be readily foreseen.

1. The costs of some economic units are understated (due to apparently costless waste disposal into water courses) and some are overstated (imposed damages and treatment costs). This tends to induce over-production and consumption of some items and under-production and consumption of others. For example, the upstream paper mill which dumps its wastes into water without bearing any of the downstream costs produces paper which is artificially "cheap". In effect, it pays nothing for the use of a valuable resource, i.e., the waste, dilution, degradation, and carriage capacity of the water course. From a social point of view, the value of this resource is measured by the alternate uses of the water. Failure of the polluter to consider the reduced value of water in other uses which are made more expensive or foreclosed entirely by his pollution is, from the viewpoint of economic efficiency, a basic element of the pollution problem.

2. Because the polluter does not consider the social cost of his actions, he is induced to produce too much waste. Because he may dispose of "waste" material at a cost to others, not to himself, he makes a lesser effort (i.e., spends less money) to design and operate industrial processes in such a way as to conserve materials, than if the full social costs of waste disposal were met. The efficacy of process engineering and materials recovery processes in reducing waste loads has been demonstrated by various instances in this country and even more strikingly in West Germany by the Genossenschaften (Regional Water Resources Authorities in the main industrial area of West Germany -- I spent a portion of last summer studying these institutions). Moreover, studies of waste loads generated per unit of physical output by plants producing identical goods but with different productive processes suggest the degree to which wastes can be engineered away. This is particularly important in view of the fact that industry produces about two-thirds of the load of organic pollutants entering the nation's streams and a far higher

proportion of other pollutants. These points emphasize the importance of regional water resources authorities providing the appropriate incentives for such procedures. A society which neglects the off-site costs of waste disposal or undervalues them will tend to produce more waste materials than is consistent with obtaining maximum production from its human and non-human resources. Furthermore, if downstream costs are not reflected in the decisions of upstream waste dischargers, there will be no treatment of waste water effluents even when such treatment is less costly than water supply treatment or the value of water use opportunities foregone downstream.

These points having been made, it appears that the way to deal with the pollution problem is to redistribute costs. As a matter of fact, under some conditions this can be considered the answer. If all the downstream opportunity costs of pollution (including increased costs of water supply treatment, recreation values lost, etc.) could be identified, expressed as monetary values, and levied upon the effluent of polluters, private incentives could be relied upon to come up with proper levels of treatment, optimal process and product adjustments by manufacturers, and appropriate industrial location decisions. All these decisions would have reflected in them the real costs of waste disposal just as they do the wages of labor, outlays for materials, and other costs.

Industrial plants would then tend to take steps to reduce waste loads by all relevant means (treatment, process and product changes, shifts in location, and perhaps others) until the costs of all these measures were equated at the margin with the reduction in damages which they produce. In other words, until the manufacturer could no longer profitably "trade off" an additional dollar spent to reduce wastes discharged into the water for more than additional dollar in reduced effluent levies or charges.

In effect, a situation would prevail in which attempts to minimize private costs (i.e. to produce output efficiently) would also produce a minimization of costs to society. This would, of course, not be the result of the laudable private motivation to minimize costs if waste disposal costs are neglected in private decisions. Similarly a system of assessing downstream costs on communities would give them an incentive to treat their wastes to the point at which the damages avoided downstream (i.e. the effluent charge avoided) is just equal to the cost of producing a further increment of treatment. These adjustments would mean that the sum of the costs associated with waste disposal (including pollution damages) would be minimized. [1]

In principle this objective can be approached by imposing effluent standards and by directly controlling industrial location instead of imposing effluent charges, and these procedures are frequently proposed and used. However, it should be understood that to use these devices in an approximately ideal manner, a pollution control authority would need at least as much and in many cases more information than if charges representing downstream damages were laid upon the effluent.

To use such devices as effluent standards and zoning in an ideal fashion, the authority would have to know the locational advantages and disadvantages of a particular site (not only the effects of location there on costs associated with waste disposal). It would have to know the opportunities for process and product adjustments, and for treatment of industrial wastes, and it would have to know the costs of all of these alternatives in order to arrive at optimal effluent standards at each location. To the degree that the authority does not itself find it desirable to operate a waste disposal system merely imposing the downstream costs of polluters upon them would, at least when damage functions are of a simple variety, accomplish desired results without such extensive knowledge on the part of the regional authority. In effect, many of the most difficult decisions would be imposed on individual decision makers who are more likely to possess the requisite information. In my opinion, study of the use of what might be called "market simulation" or "effluent pricing" as means of decentralizing decisions is highly important.

Procedures like these become even more interesting when hydrologic variability and collective measures for waste disposal are taken into account. These are points I would like to come back to. Another intriguing possibility which I would just like to mention is the use of effluent charges or prices as means for quality coordination of large river systems. This might involve treating tributaries as effluent in outfalls, and levying charges on them in accordance with the waste load they carry.

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[1] It is notable that this result does not require the payment of compensation to injured parties -- indeed, if compensation is to be paid on equity grounds, the manner of payment must be carefully framed to avoid introducing inefficiencies.

It may, of course, be argued that downstream damages (such as reduced aesthetic or recreational amenity) defy evaluation and cannot therefore be accurately mirrored in effluent charges. Two points can be made in this regard -- (1) Considerable steps have been made toward providing a basis for assigning at least minimum values to water resource related goods commonly termed intangible (I will return to this point later), and (2) A moment's reflection will show that whatever regulations are adopted (say, effluent standards), imply an evaluation of downstream costs. For example, if we impose an effluent standard on a community or an industry which it will cost $1 million to meet, we are in effect saying that at least $1 million worth of damages are avoided downstream. In my view, the possibility of using effluent charges as a flexible and effective administrative tool merits serious attention.

Effluent charges have not been used on a regional basis in this country. However, it may be said that procedures such as effluent standards and zoning may be viewed as efforts to produce more socially meaningful distributions of costs.

Does this mean then that the function of regional water resources authorities with respect to water pollution is simply to administer better distributions of costs? The answer is no in all instances where some of the most economical methods of controlling or managing water quality are not available to individual industries and communities in the planning area. When this is the case the problem of regional waste disposal system design presents itself.

System design arises as a problem in addition to seeing to it that costs are distributed properly when economies of large scale exist in waste treatment, or when measures such as augmentation of low streamflows by reservoir releases or artificial reaeration of streams are efficient alternatives or supplements to treatment over certain ranges. In other words, when economical abatement measures exist, which cannot be undertaken by individual polluters. Or to put it still another way, when collective measures permit water quality to be managed at less cost than if devices used for this purpose are limited to what can be done at the individual effluent outfall or water supply intake.

In virtually all highly developed regions efficient alternatives will be available the use, or the "best" use, of which cannot be induced by levying the net social costs of their pollution on polluters. 1/ In these cases a social cost minimizing solution will demand planning of the system by an organization which can comprehend the significant large-scale alternatives. Such an organization (presumably a public agency in the U.S.) is thus confronted with the dual problem of designing the system and allocating system costs in such a way as to induce efficient use of alternatives the planning and operation of which it does not control directly. The latter would ordinarily include, at least, process and product adjustments by manufacturers.

Among those measures a regional authority might well plan, construct and operate directly in order to take advantage of economies of large scale are the augmentation of low streamflows from reservoir storage, treatment of effluents where they can economically be brought together from diverse sources for collective treatment and treatment of entire streams or mechanical reaeration of streams.

Let me briefly indicate what one might call ideal economic characteristics of a regional system of waste disposal which would minimize all costs associated with waste disposal alternatives including pollution damages. It may seem strange to include pollution imposed costs or damages as an alternative because such damages use up resources, i.e., cause social costs -- but so do abatement measures. The problem is to achieve an optimal balance between damages and abatement. It would seldom if ever minimize social costs to eliminate pollution. This was, of course, also implied previously, in the discussion of effluent charges. In a system which achieved a cost minimizing balance between alternatives it would be impossible to reduce costs by "trading off" between alternatives. Another way of saying this is that the marginal or incremental costs of all relevant alternatives would be equalized. In such a system costs could not be lowered by doing a little less sewage treatment and permitting a little more pollution damage, or by doing a little more augmentation of low flows and a little less treatment of sewage, or by doing a little more engineering away of wastes and a little less water supply treatment, and so on for each set of alternatives.

1/ Strictly from an efficiency point of view, the same results can be accomplished by paying the polluter a fee to reduce waste loads equal to the net damages avoided downstream. The principle is that the polluters must view downstream costs as their own opportunity costs. This can be done either by means of a subsidy or a charge. For simplicity the discussion of this paper is developed in terms of charges.

If the augmentation of low flows is one of the alternatives, then its cost is lowered (and it "trades off" better) against other alternatives, like waste treatment, if it simultaneously serves other purposes like maintaining the stream high enough to maintain navigation. Conversely, if the stored water can be put to other uses, like generating power, flow augmentation "trades off" less well against other alternatives.

A regional authority with the power to plan, construct, and operate, and finance abatement works could well utilize such economic criteria as guidelines since minimizing the costs associated with waste disposal in the sense that I have used the term is not only consistent with but required by the widely accepted objective of obtaining the largest net benefit from water resources.

Indeed, the statements so far made in regard to minimizing costs could as easily be couched in the benefit-cost terminology familiarly used with respect to public water resources investments. For example, if all damages avoided are termed benefits and abatement measures are carried to the point where their costs equal damages avoided at the margin, this could be said to produce maximum net benefits instead of minimum costs. The fact is that the statements are identical. To me the cost minimization terminology is simpler, especially when more complex situations with respect to the evaluation of some pollution costs are under discussion. I shall return to this point later.

Since some of the more important decisions affecting the amount and character of wastes entering the system, and governing the methods used to adjust waste loads in industrialized basins, might best be left in the hands of private decision makers (i.e., waste recovery, process and product changes, industrial location, pre-treatment of wastes), the regional authority would have to plan carefully to provide incentives for the optimum use of these measures. I have already suggested that effluent charges might plan an important role in this regard.

To carry the point further, when scale economies in treatment, opportunities for flow regulation, reaeration of streams, etc., present the regional authority directly with the problem of system design, the use of a method of distribution costs of the system by means other than tying them to the construction of specific abatement works becomes essential.

For example, economies of scale in treatment may mean that wastes from factory A are given far-reaching treatment because it has a large effluent volume and costs per unit of waste removed are comparatively low. Say plant B has only a very small effluent volume and treatment would be very expensive. Desirable (cost minimizing) stream conditions may be attainable by treating only factory A's wastes at low cost and not treating B's at all. If an appropriate method of assessing costs exists, part of the cost will be paid by B, and both A and B can benefit because total costs are lower than they would have been if the same result had been achieved by two smaller plants. Moreover, and very important, both plants will have an appropriate incentive to reduce their waste loads. The German Genossenschaften, the Associations which manage water resources in the Ruhr area of West Germany and which I have mentioned earlier, provide a precedent by having worked out rather far-reaching procedures along these lines.

I have certainly greatly oversimplified the problems of planning a system. For one thing, adequate evaluation of some types of pollution damages, for example, to aesthetic amenities, to recreation, and in some instances to public health, has a long way to go. I wish to speak further of these matters at a later point, but first I would like to refer briefly to one other complication in the economics of regional waste disposal systems. This is the problem of streamflow variation. As all of you know, the concentration of most pollutants in stream waters is not steady over time even when the amounts discharged are. Rather it is inversely related to the rate of streamflow. Thus pollution damage tends to be heavily concentrated in periods when streamflows are low. This presents problems not only for system design but also for devising means of providing waste dischargers with the incentive to vary waste discharge with streamflow (in other words, to concentrate discharges in high streamflow periods) to the extent that this is more economical than alternative abatement measures or than permitting pollution damage.

I won't speak much about the system design problems resulting from hydrologic variation. I just wish to make two points: (1) streamflow variation means that the costs of pollution damages and abatement measures become matters of mathematical probability rather than being determinate and fully predictable through time, and (2) the fact that we are dealing with events which reach high intensity only on comparatively rare occasions means that in the interest of minimizing costs over time, careful attention should be given to alternatives which may involve high operating costs but which require relatively little capital investment. For example, the use of high rates of aeration in activated sludge plants, addition of chemicals at the primary state of effluent treatment, occasional barging of wastes to the sea, etc. These alternatives involve high operating costs but since they need be used only rarely and for comparatively short periods of time, they may often be found to "trade off" positively against additional investment in reservoir capacity for flow augmentation or increased size of treatment plants. Illustrative calculations applying a rate of time discount to expenditures repeated at various time intervals indicate that for reasonable low flow intervals (say, around 10 years) and rates of discount (say, around 5 per cent) about sixty-five cents could be spent for operating costs during every critical low flow in perpetuity without having the present value of the expenditure stream exceed a dollar of current investment. This emphasizes the importance of what one might call the economics of the rare event in designing waste disposal systems on which the biggest demands come only at comparatively long intervals.

I wish, however, to spend a few more minutes on the matter of providing appropriate incentives (especially to industry) to vary wastes discharged into the system over time.

The point has already been made that the costs associated with pollution vary strongly over time. This is certainly true of damages. Since the concentration of pollutants rises during low flows, fish kills, increased water treatment, costs, effects associated with salinity, and hardness, and, in waters extremely heavily loaded with organic pollutants, anaerobic nuisance conditions are more likely during low stream stages. The costs of operating a quality control system in an optimal fashion also rise during such periods. During these times chemicals would be added to aid precipitation, aeration rates would be stepped up, power turbines and other devices might be used to increase reaeration of the stream, and low flows might well be augmented by reservoir releases. In regard to the latter, while there might be little out-of-pocket operating costs, costs of foregone opportunities arise if there are substitute uses for the water. The costs may be foregone peak power which could have been generated or lost recreation opportunities due to drawdown of the reservoir.

Thus it is clear that the social costs of pollution (including the cost of damages and the cost of abatement measures) rise strongly during periods of low flow. Consequently a rationale exists for levying charges on effluents in a variable way in much the same manner that electrical utilities levy higher rates for "peak loads."

If it were clearly uneconomical to change the amount and/or quality of waste discharge over short periods of time, it might not be a matter of great concern whether or not costs levied upon polluters varied correspondingly over time. However, it appears probable that measures to change the pattern of discharge would enter economically into a quality control system designed to minimize costs.

For example, depending upon the location of a manufacturing concern and upon attendant land values, it may be less expensive for the company to withhold its waste discharge temporarily in a lagoon rather than bear its share of the costs of storing and, at long intervals, releasing a much larger volume of river water. In addition, if retention time is significantly long, such retention ponds will provide a degree of organic waste stabilization. In some instances, especially where the product is storable, it may be more economical to reduce or halt production during low flow periods rather than to provide additional treatment or dilution capacity for an unchanged effluent. In other instances it may pay the manufacturer to provide temporary treatment (like chemical neutralization of acids) rather than meet the full costs of putting his effluents into the receiving water during low flow periods. In light of such possibilities, incentives should be provided to use them to an optimal degree.

Application of peak load pricing would, however, require more or less continuous monitoring of effluent quantity and quality. My understanding is that recent technological developments in automatic monitoring devices hold promise that comparatively simple and inexpensive devices may be used to continuously measure a variety of quality parameters. It is probably not visionary to foresee a time when regional authorities will be in a position to continuously and economically record relevant indicators of pollution for every major outfall in an entire basin.

So far only a few nods have been made in the direction of the substantial measurement problems which beset at least some aspects of attempting to minimize the costs (including damage costs) associated with waste disposal. I would like to make a few further comments about this.

Some suggestive methods for the approximation of "intangible" values like those involved in aesthetics and recreation have been made. I do not believe it is too much to hope that in the course of time reasonably dependable economic estimates will be made to aid the decision process. Some of this work is being pursued at or with the cooperation of RFF. I would be pleased to comment in a general way on it during the discussion period, or later, if there is specific interest in these particular problems of quantification. However, this remains one of the most important areas of research having to do with the design of regional waste disposal systems as well as with other aspects of water resources development and use.

Furthermore, such values cannot be neglected until satisfactory measures are developed. Consequently it may be useful to say a few words about how they may be incorporated into a system design which aims at cost minimization. To neglect the aesthetic and environmental amenities, and the recreational value of water even when their value cannot be measured, is obviously wrong. How then to include them? One attractive possibility is to make explicit judgments concerning the physical effects needed to achieve certain tentatively set goals. In other words, to design a system which includes these goals (in physical terms) as constraints upon the cost minimization objective.

For example, a public decision might be made to protect (say) recreation in a stretch of stream where the values destroyed in other uses of the water (for example, in industrial uses) are small relative to the cost of maintaining high water quality in the stream. 1/ If we wish to use the benefit-cost terminology (which would equate damages avoided with benefits), we can say that in this case costs, but not all benefits, are determined on a market-value basis. I prefer the logically equivalent terminology which emphasizes that waste disposal involves only costs and that the economic objective of a waste disposal program can be conveniently stated in terms of minimizing these costs. In this terminology the case just indicated can be described as one where abatement costs are explicitly quantified and used in planning pollution abatement, but at least some damage costs are not explicitly quantified. Rather they are represented (perhaps reasonably accurately, perhaps not) by "standards" or "requirements". Such a standard might be that 4 ppm of dissolved oxygen be maintained in a stream at a given design flow. In federal agency evaluation practice (where formal benefit-cost analysis of quality problems has been limited to the evaluation of low-flow augmentation with water supply and sewage treatment usually

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1/ This proviso is made so that the recreation goal will not be automatically met if the measurable costs are minimized, i.e., to assure that the protection of recreation is in fact an effective constraint.

the only alternatives considered) most or all of the "benefits" have ordinarily been a transposition of such standards rather than the evaluation of actual damages or losses avoided. For example, if a standard of 4 ppm D.O. is set, the alternative cost of achieving this standard by (say) supertreatment is calculated and this cost is termed a benefit. While I don't wish to spend much time on largely terminological matters, this seems to me to obscure some rather important differences. I would prefer to say that the objective is not the maximization of net benefit in this case (where benefit has to say the least an ambiguous meaning) but the minimization of measurable costs given certain constraints representing values which cannot be (or are not) stated in directly commensurable terms.

Let me return to the example previously begun, however. If social choice dictated that a stream must at all times remain suitable for the support of a specified type of fish, public policy would be to produce a system which minimizes the real cost of waste disposal, subject to the constraint that conditions unsuitable for fish are nowhere to develop. Conceivably this would require a very different combination of units with different operating procedures than a system designed without the constraint. Presuming the constraint is effective, i.e., not automatically achieved if costs are minimized, it would result in a higher cost system than could otherwise have been achieved. The extra cost represents the limitation which the constraint places upon the cost minimization objectives. Marginal conditions analogous to those indicated earlier (i.e., the equalization of marginal costs in all directions) must still hold for the cost minimization objective. In other words, the optimum system is not attained until a situation is reached in which it is impossible to achieve lower costs by making marginal "tradeoffs" between alternatives without violating the constraint. The marginal costs affected by the constraint now, however, contain an imputed element which derives from the limited supply of the constrained input (say, dissolved oxygen). 1/

1/ In principle, constrained maximization problems of this kind are solvable by the use of differential calculus and a method known as La Grange multipliers. The multiplier indicates the marginal cost of the constraint in terms of the objective. Problems of this character can also be cast in linear programming form, in which case the "dual" indicates the marginal cost of the constraint. Perhaps the most immediately promising optimization procedure for waste disposal system problems is a technique involving computer similation and various methods of sampling results of trial runs in order to approximate an optimum.

It is worth remarking that effluent charges or some other means of inducing an optimal balance between process and production adjustments and other measures such as flow augmentation, treatment, artificial stream aeration and perhaps others are still needed. The principles involved here are very interesting and not too different from the simpler situation discussed earlier, but I do not have time to go into them here.

The decision model type of framework which has been sketched is very flexible and can be used to combine efficiency and policy goals. However, from the point of view of achieving minimum costs associated with waste disposal, the policy constraints should be considered provisional, and viewed as subject matter for research and study in order to expand their meaning with respect to the preferences of society. One way of studying them from this point of view is to test their cost sensitivity. By varying a constraint by small amounts, redetermining the optimum system, and collating the change in costs with the associated physical changes (i.e., effects on oxygen levels, appearance, aquatic life, etc., in specific stretches of stream), information can be provided which would permit considered choices to be made by representatives of the public.

One useful way of stating the results of experiments with the constraints which are not commensurable with the objective (i.e., not valued directly by or imputable from markets), is in terms of what they must "at least be worth". If, for example, a social judgment were to be made that algae growth is to be restricted (say, because of its effect on the appearance of water) beyond the point indicated by the cost minimizing solution (i.e., algae limitation is an effective constraint), it would, of course, not be possible to say precisely what the avoided destruction (real cost) of aesthetic pleasure is worth. However, by comparing optimum systems with and without the constraint, it would be possible to indicate to the public representatives what the least value is that must be attached to make that level of control procedure worthwhile.

However, at this point we are forced to call upon the political process to make a specific judgment about resources allocation, at least until our skill in measuring values becomes considerably greater, even if we accept efficiency as the design objective. In my view one of the most important research problems in the field of water quality management is how complex and specific decisions of this kind can be made via the political process in a socially justifiable manner. How can the appropriate "public" be identified? What media are there for giving them really relevant information? What political institutions are there that will permit this public to communicate its preferences? How can the direct and intensely felt effects of the system on some portions of the public be brought into a justifiable balance with less direct and less intensely felt effects on others? How can political and economic procedures (say, user charges) be combined so that beneficiaries of such a system are disciplined in their decision making by the costs of the project?

Actually the last several comments have broached another matter I was specifically asked to comment upon -- that is, the matter of research needs. I have already indicated that I feel some of the most important and difficult research needs in the general area of achieving efficient regional waste disposal systems are in an area where economics and political science merge. In order not to impinge too much on the assigned domain of the other speakers, I will not push further in this direction.

The previous discussion of economic aspects of efficient regional waste disposal suggests a number of areas of research in addition -- some in economics itself and a great deal of supporting research in other disciplines. While we are far from being able to estimate many relevant economic magnitudes with a desirable degree of accuracy, the same is true to a considerable degree of other disciplines relating to regional water quality management problems. For example, sanitary engineering research has not traditionally taken a regional approach. Consequently there are many severe gaps in the types of scientific and engineering information needed in the design and operation of regional waste disposal systems.

I have elsewhere 1/ categorized what seemed to me to be the major broad areas of research which grow out of considerations of economic efficiency with respect to waste disposal. I will merely list them here. I will not include general problems in the application of economic analysis to water resources problems such as determining appropriate rates of time discount, dealing with market imperfections, and other general problems about which there is by now a considerable literature and which are probably familiar

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1/ Allen V. Kneese, Water Pollution - Economic Aspects and Research Needs (Baltimore: Johns Hopkins Press, 1962) to most of you. If the audience so desires, I will gladly be more specific about the following research categories during the discussion period and also indicate some of the work which is now going forward in these areas and which I happen to know about. The research categories are as follows:

(a) Procedures for keeping track of quality changes and quickly computing the concentration of pollutants (and significant associated variables such as D.O.) at all relevant points of use, as a function of a variety of conditioning factors. The latter include waste loads at particular outfalls, biological, chemical, and physical conditions, and volume of stream flow. This point actually implies considerable expansion of existing scientific knowledge, especially in regard to the complex factors which interact with residual plant nutrients to give rise to algae growth and the effects of algae on oxygen balance.

(b) Information on the costs of waste disposal. These include sewage treatment, water supply treatment, reclamation of waste materials, industrial process changes, methods of controlling streamflow or conforming waste discharges to flows, and pollution damages to municipal, industrial and on-site uses.

(c) Improved means for the prediction of pollution loadings -- especially those resulting from industrial waste disposal. These should provide a reasonable forecast of the effects of environmental conditions such as water costs, effluent charges, foreseeable technological changes, and various kinds of public policies. This implies careful study of what might be called the economics of water use and waste disposal in the plants of specific industries.

(d) Improved techniques of calculation for approximating optimum multipurpose multi-unit system designs when the objective is constrained in various ways. These techniques should be capable of handling the very considerable complexities introduced when waste disposal, and attendant water quality variation, is included in the design problem.

DISCUSSION OF PAPER PRESENTED BY ALLEN KNEESE

James A. Crutchfield*

I should like to begin by stating that Dr. Kneese has violated one of the basic rules of the profession by providing me with a copy of his paper well in advance. I cannot, therefore, plead ignorance of it.

As might be expected of an acknowledged expert in the field, Dr. Kneese has done an excellent job in this paper. Perhaps I can add usefully to the discussion by emphasizing what seem to me the critical points in his paper and by some elaboration of measurement problems to which he has alluded briefly.

The most significant contribution of the paper is the author's insistence on viewing the economic problem of pollution in terms of a schedule concept, in which water quality is viewed as a range of products available at a range of costs. Perhaps the key sentence in the paper is that "elimination of pollution is seldom a minimum-cost solution." The black and white approach, in which the choice is viewed as one of "pure" water versus water polluted to the danger point is absurd and has produced a great deal of unnecessary disagreement between control agencies and industrial waste producers.

Dr. Kneese sets the problem in terms of cost minimization which is logical and operational. Abatement of pollution, with its attendant costs, is balanced against the costs of allowing the pollution to continue, measured in terms of benefits foregone, or measured in terms of additional costs imposed on other users of water. The major difficulty, of course, lies in the fact that it is possible to identify clearly the money costs of pollution abatement, while the social costs imposed on other water users are usually so diffused that the physical damage involved is not easily identified or assigned. Moreover, many of the alternative water uses are not market priced, and cannot be valued in any simple way.

In general I would agree fully with the author's position that a regional approach to water pollution analysis is required for development of optimal economic solutions. There are, however, some dangers of an ad hoc nature in regional analysis of this type. For example, if the analysis is extended to a region as a whole it is possible that the impact of pollution (or the abatement of pollution) on the output of other products may be sufficiently great that product prices are affected. Since the usual analysis involves projections of present prices, the possibility of significant errors arises.

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*Associate Professor, Department of Economics, University of Washington, Seattle, Washington.

The second problem is more serious. If the social costs of pollution are identified and converted to specific money costs for one group of waste producers but not for others, it is possible that severe damage to one segment of a regional or national industry might result. Situations in which firms are locally specialized from the standpoint of raw material supplies but participate in larger national markets for final products are by no means uncommon. In such cases it may be necessary to consider sub-optimum solutions until and unless the same treatment of social costs is extended to all firms in the industry.

As Dr. Kneese indicates, the measurement problem is crucial to the usefulness of his concept of optimum system design (including proper allocation of costs) as a technique for rational solution of pollution problems. These problems are real, but they appear to have been complicated further by careless use of concepts and definitions. For example, it is difficult to make consistent sense out of the distinction between tangible and intangible benefits from water utilization. If the distinction is intended to apply to services as contrasted to physical commodities, it is simply irrelevant. Services comprise an important segment of total production, and in the last analysis physical commodities are desired not for themselves but for the services they render. In some cases the term "intangible" is used to distinguish nonmeasurable costs and benefits as contrasted to those that can be measured. This seems legitimate (if somewhat imprecise), but its usefulness is reduced by frequent failure to distinguish water uses (opportunity costs in Kneese's terms) for which measures of economic value are inherently impossible from those where the difficulty is simply a result of public policy (or concealment of essential information by interested parties).

We might illustrate some of these points by reference to outdoor recreation in general and sport fishing in particular. In many cases the use of water resources for outdoor recreation is free, and even where charges are levied they are seldom geared to any concept of rent maximization. More commonly they are intended to cover direct management costs for the recreational service involved. This doubtless makes the measurement problem extremely difficult, particularly where we must estimate even the number of actual users. But is this inherent? I would argue that it reflects a prejudice, rarely though through or justified in rational terms, that outdoor recreation should be freely available to everyone without charge or at nominal cost only. But surely hunting, fishing and outdoor recreation, desirable as they may be, are less important to most people than food. shelter, and medical services -- to name only a few essential goods. Why is it necessary to subsidize a recreational service, by making it available at less than its true economic value and rationing limited supplies in other ways -- e.g., bag limits on fish and game, limited reservations at public parks, etc. We are probably "overproducing" such water-using services as hunting, fishing, and boating by failing to charge a more realistic price for the service rendered by the basic resource; and, in the process, we are reducing the quality of that service. Surely by this time it should be clear, as Dr. Kneese has stressed repeatedly in his paper, that the notion of "free" water is a fiction.

Another measurement problem of intense interest in the Pacific Northwest involves the valuation of commercial fisheries. Because we allow virtually unlimited entry to the commercial fisheries the net economic benefit, in conventional benefit cost terms, will always tend toward zero. If prices and costs were such that the net economic yield from an anadromous commercial fishery were positive, new entrants would immediately dissipate this economic rent in increased costs. This stands in sharp contrast to the valuation of competing water uses, in which it is assumed that water rights are limited and are managed in such a way as to yield the largest net economic benefit, given existing technology. For full comparability, then, the commercial fisheries ought to be valued in terms of the largest net economic yield that could be achieved under rational management. This would require merely that permissible catches be taken with the minimum number of units required, each unit being equipped to operate as efficiently as the state of the art permits. On that basis it is likely that the net economic yield of the Columbia River fisheries, for example, would be not less than 75 percent to 80 percent of the gross market value of the catch -- perhaps $15 to $20 million per year.

In effect, the valuation of many water uses now regarded as "intangibles" and the pollution problem in general would be vastly simpler if handled within the pricing mechanism of the market economy. Even where the products or services are not priced directly we can simulate this process effectively in many cases. I would repeat again Dr. Kneese's major point that rational policy decisions regarding water quality must be carried out in terms of the costs of achieving varying qualities and the costs imposed on other users by varying degrees of pollution.

Lest this be construed as an apology for lax handling of pollution problems, I would add that this type of analysis would certainly point to the desirability of pollution abatement in many instances. I would also emphasize strongly that many of our decisions with regard to water utilization -- particularly where they involve fish, wildlife and other aspects of outdoor recreation -- are irreversible. We would do well to err on the side of caution if there is any reasonable doubt about the possibility of permanent pollution damage or of a water use pattern that maximizes economic values in the short run but neglects the increasing real value of outdoor recreation facilities as population pressure and incomes rise.

Again, I am deeply impressed with the way in which Dr. Kneese has set these problems within a framework of recognized economic analysis. This would appear to take us a long way in the direction of more rational choices among competing uses of water.

DISCUSSION

Q. Mr. Kneese stated that basic research is needed in the development of a political organization or water authority with appropriate jurisdiction and power. I wonder, with his experience in the near past in Germany, if he will comment on the workings of the organization that deals with the handling of wastes from the Emscher to the Rhine? I am sure they dealt with the allocation of costs among water users and possibly their implementation as far as penalty costs are concerned.

A. There are seven organizations to which I made reference and which I visited this past year in Germany. Actually, only two of them, when you combine them in the way in which they are functionally combined and neglect some nominal distinctions, control most of the water resources in the industrial area of West Germany, which is an extremely water-short region. (The combined annual low flow of the rivers that service this area, which has eight million people and 40 per cent of Germany's industry, is about one-half of the low flow on record of the Potomac River and considerably less than that of some of our larger rivers.) They do not fully control all the variables that go into the regional management of water resources. There is in addition a land planning authority to plan for land use in an 18-city area which includes all of the major industries and cities of the industrial area. They work rather closely together. They have designed a system very much along the lines that I have outlined. It's done very much in an ad-hoc fashion but they trade off alternatives. In the region as a whole they have used all of the alternatives at one time or another that I mentioned in my talk. They do so in a cost-minimizing way. They do not have explicit evaluations for recreation and there are undoubtedly recreation opportunities destroyed in certain areas. The logic used in the area is a rather extreme stream specialization where they are maintaining the Ruhr River and the Lippe River in good shape for water supply and recreation throughout most of their length. There is even some zoning on them and there are one or two places in the Ruhr where pollution is bad, but the Ruhr is suitable for swimming, for instance, at Essen, which amazed me.

They have sacrificed in other rivers - the Emscher has been turned completely into a sewer. It is limed, is aesthetically inoffensive, but it isn't useful for anything except to put wastes in. The wastes going to that river are given only primary treatment and some industry treatment. The entire flow of the Emscher River is then treated before it is emptied into the Rhine. Presently primary treatment is used.

There is now an international authority which has been investigating the fact that the Rhine is heavily polluted not only from the Ruhr industrial area, but from elsewhere. As a result, they are building an activated sludge treatment plant for the entire Emscher flow before it's delivered into the Rhine. They have made extensive use of rather extreme economies of scale in this fashion. With respect to this problem of articulating industrial engineering decisions with a system of this kind, here they do use a system of cost allocation. This is far from an ideal system, but twice a year they sample the effluent from all the major industries. It doesn't matter if they discharge into a treatment plant or a municipal system, or discharge directly into the river, they are all sampled. They have formulas which are rather arbitrary in some respects, but they provide methods of integrating various units of pollution, such as settleable material, B.O.D., and the toxic pollutants. Every individual industry pays the operating and capital cost of the facilities in the area on the basis of its polluting value which is in essence an effluent charge. These folks, of course, are dealing with the world's most concentrated industrial area and undoubtedly an institutional arrangement of this kind - not necessarily involving the same political structure that it does - would only be suitable for highly developed industrial areas where there are large economies of collective action to be realized.

In other instances, only a modest amount of coordination in one way or another, whether by effluent standards or effluent charges and imposing downstream costs on upstream polluters to induce cost-minimizing behaviors, may require a very modest organization. As has been pointed out, the really important research is in the area of defining institutions which are correct for dealing with the problems in the particular regions.

Q. Is not this waste from Germany dumped on the Dutch who have no resource by which to pay for the increased treatment required to preserve their waters?

A. That's true. In the present situation, Germany does treat the waste before putting it in the Rhine. Some wastes will be given full biological treatment. The assimilating capacity of the Rhine is large. It has a flow roughly that of the Ohio River. When this treatment plant is constructed, virtually the entire waste load - industrial, municipal - from the entire industrial area will be subjected to a very high degree of treatment before it goes into the Rhine.

PUBLIC AWARENESS AND INFORMATION

Marko L. Haggard*

First, I want to say that I am not an expert on public opinion as related to water pollution. I have tried to spend what talents I have in the last few years seeking to understand political behavior and primarily that which deals with voting on revenue measures. I am not sure to what extent this is relevant to your problems. One of the difficulties I have in looking at the problem assigned today is that I am not cognizant of what particular public policies are in process or are going to be proposed, so if my comments are not germane, I regret it. However I hope that I'm roughly in the area involved by your particular programs.

I think it is safe to understand that in your program of pollution control you're certainly dealing with virtue. I am sure that if we were to do a public opinion poll, and ask people, "Are you opposed to water pollution or air pollution?" we would get a response similar to the polls we have in America on the question, "Do you believe in God?" It would not be surprising if the percentages would be in the high 90's. I doubt if such a questionnaire on pollution would mean much.

As we look at the problem of public information and awareness, let us first direct our attention to the question of the extent to which the "Public" is aware of and understands the meaning and implications of water quality depreciation control. I do not know of any studies that have been done recently in this area that would answer that question. The first need for research as part of our public opinion process is that we ask the questions that are germane to that question, but are of a more subtle order than the one I just suggested. For example, we have recently done the most thorough study that I know of to date about political attitudes in Multnomah County, Oregon. Unfortunately, we did this with more aspiration than we had resource for achievement. However, it has been programmed and the machine in Los Angeles has sent back 30 packages of data and is still grinding. I'm at a college which is bedeviled with having no resources so I am now with piles of data which I am sure in time we can analyze and which will give us some clues that are possibly germane to today's subject although I didn't design this interview schedule around this theme. Actually, I designed it, among other things, to explore the problem of attitudes toward fluoridation.

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*Assistant Professor of Political Science, Portland State College, Portland, Oregon.

Fluoridation failed in the recent election. I've made some attempts to study that election and it seems to me that if you are now moving toward the point in which you wish to propose certain kinds of concerted action about pollution -- water pollution in particular -- I can't imagine a more fortuitous time. The only happy thing which came out of the results of the vote on my "God-given right" to continue to have tooth decay is that a major reason advanced for voting against fluoridation is that it would alter or destroy our pure water. I have not been so aware of the dramatic implications of water since my childhood days in Nebraska when I happened to come along during the drought and water had a certain significance. I remember going to summer camp and being able to walk on the river bed every summer. That was not a miracle, if you are thinking of that allusion. Nor, since the days of the army when, of course, as we were giving our All, there were moments when water was most precious. Since then I have not had a sense of the tremendous dramatic impact that water has for a lot of people, and I think that this is a very propitious time to exploit this attitude that so many people are expressing concerning the reason why they voted against fluoride and make it your argument and put the opposition on the defensive with it.

I can't imagine anyone willingly and deliberately championing pollution -- this is incredible. Then, put the opponents on the defensive as proponents and organizers for pollution. Above all, champion this cardinal thing that is dear to many -- their pure water. We're sophisticated enough to know that we don't want to analyze that water too deeply, but the point is there may be times in which means and ends are of such relevance, in which social policy is so desirable, that it might be wise in the general vein not to over-complicate the issue.

More specifically, I would like to just talk a few minutes about some of the general propositions that we know are fairly true about public opinion as a phenomenon and about the role of interest groups and then ponder the applications to your specific problems. These will have to come in part from your own knowledge, but I wonder to what extent they may apply. The very first question is the extent to which the "public" is aware. The students of public opinion would immediately react to that question. I say, not in a critical vein, but in an explanatory vein, that there is *no such animal as the "Public."* First, the student would want to ask *which Public one is talking about*. Again, one can't refine this in more detail *until one knows the specific policies that might be apropos*. The fact is, however, that any attempt that will be made by any group -- be it public or private -- to try to influence policy which may involve public opinion as a phenomenon, must recognize that it has to operate in certain given sets of environments. I think a basic problem that might be posed for this subject is the fact that you may have volumes of professional and expert knowledge and yet it can be relatively meaningless to the rank and file of the people unless it is adequately and properly communicated. That means ridding it of a considerable amount of jargon. Take, for example, the tremendous best-selling record of Rachel Carson's "*Silent Spring*" as a clue. Rachel Carson has touched a very sensitive nerve and it is a sensitive nerve that is fraught with all sorts of difficult prospects. She, on the one hand, had the ability to translate scientific data into poetry or an imagery that approximates poetry, the ability to have us reaffirm our identification with and our respect for Nature. That is a latent kind of identification that a lot of cynical people might not be aware they have. The thing that disturbs me about some of the comments I have seen about the book is that perhaps the book comes at a most fortunate or maybe an unfortunate time. We are a people who are caught on the abyss of possible destruction -- we are a people that have had to live from crisis to crisis. We are a people who know that capacities to overkill are in the range of 10 to 25. There is a thin line where you can project a whole series of horrors or prospects and if they're not projected with a certain sobriety, a certain sympathy and understanding -- you get a hysterical reaction. The point is that I get alarmed that we have such a thin edge here on the part of many publics of almost quasi-hysteria. It seems to me if there are pronounced problems of pollution, that we must be careful in projecting these so that we don't over-simplify them in this kind of negative emotional response. On the other hand, I would sincerely urge that the public relations boys have some lessons to teach us about public policies. We may well need to use to advantage some of the techniques they use, whether we like them or not.

Our society clearly demonstrates one thing -- knowledge is not self-enforcing, virtue doesn't triumph just by the fact of its being virtue, there must be concerted attempts to influence attitudes and opinions. These things must be deliberately calculated.

I would think, in terms of research projects on public attitudes and awareness, one which would be of immediate interest would be to try to sample a group of the people who watch the showing of the KGW-TV film, "Pollution in Paradise." To my knowledge there has not been any concerted attempt to approach this problem of pollution via TV. I think, in order to approach this project without making it so simple and so obvious, we need to explore certain attitudes and opinions that people might have about whom they have respect for, and policies they have respect for. One of the problems that would be posed is that all things being equal, governmental agencies ought to be auxiliary agents in this respect rather than the promoters. As a people we have a marvellous ambivalent attitude about politicians and politics and associate them with that word, "bureaucrats." Dead politicians are marvellous, and assume statesman-like proportions. Living ones are the Devil Incarnate. In a poll taken not so many years ago, American mothers were asked to write the things they would like their children to be when they grew up -- among the things asked was running for public office -- if I remember correctly, politicians came in at a rating just above a "pimp."

Students of public opinion know that in our society there are certain outer limits that one can't exceed -- certain rules of the game. One of them is the broad notion of equality, that while we're all equal, some are more equal than others. This is particularly relevant in terms of influencing attitudes and opinions.

Another proposal I would make has to do with certain kinds of community studies. One of the most intensive studies we had in this area shows most people do not participate in public affairs and activities. This is a phenomenon that is peculiarly confined to middle-class, white-collar, and to a great extent professional and business groups. A large number of people, particularly in the larger urban areas, are not active virtually in anything. At the most they may be active in a sporting event or possibly in a school PTA, although the study we did here and which has been confirmed in many other community studies in many other parts of the U. S., showed that the bulk of people who had children of school age were not identified with or active in any of the school organizations.

We also have enough information to know that there are many people not active, but also that every community or area has certain opinion leaders and these opinion leaders may not be the people you necessarily read about. For instance, I bet that the revenue measures would lose in the last election. From our studies a "No" vote was predictable because the groups that were most active in trying to get those measures adopted were groups that were talking to themselves. They were already going to vote "Yes." They were largely professional people and particularly they were going to vote "Yes" on the measures which provided money for convention facilities.

Also, we have a series of studies which show clearly -- it's more than quantitative, it's statistically significant -- that here in Portland the higher the democratic party registration, the greater the "No" vote on revenue measures. For example, on school measures, etc., the areas that have some of the largest number of children had the greatest number of "No" votes on school bond measures. For some reason, most of the groups advocating the revenue measures did not seek to try to determine or even examine the research data because, probably, there is a certain group in society who, being active all the time, confuse themselves with the "Public," and are surprised that they and the Public may not be the same individuals as suggested by the election results. One of the problems that would be involved, if you are going to affect the voting process in terms of revenue measures, is to be cognizant that there is a taxpayers' revolt. It's a taxpayers' revolt which may be indiscriminate from your viewpoint of the necessity for providing certain functions, but the taxpayers are revolting at the only place they can. Witness, there's nothing the taxpayer can do directly to revolt against where the bulk of the money is spent, namely, the Federal Government. If he's sufficiently organized, he can manage to put through a tax bill which will definitely prove some people are more equal than others. But the average person (so-called) who is unorganized, still is eligible to exercise the suffrage. He is a creature and victim of circumstances, many of which he can't quite clearly delineate. He knows we have to have a defense policy, that there are crises, but that he, when he goes to vote, cannot directly through the suffrage affect but at the most three people at the federal level -- the congressman in the district, the two senators, and, every four years, the President. That's all. There is no place where he can direct his immediate reaction to these irritations except on those measures on the ballot that clearly have money involved. People are going to attack those areas that are identifiable. This is to be anticipated. It's something similar to the trouble we have in discerning corruption. One of the hardest things to try to get explored is big corruption. As a people, we understand physical objective corruption -- we understand mink coats, deep freezes -- we can identify these. It is of a different order for us to try to identify what is the proper resource policy -- the best distribution, let's say, of the use of water in a given area. This is of an order entirely different -- it doesn't have the same kinds of definitions. When we look at this problem we need to find those things that are concrete and identifiable.

This again could be turned to advantage for those who wish to do something about the problem of pollution. You can make the aspects of pollution as vivid, as real, as immediate as any type of subject matter. If it involves revenue -- particularly anything that deals with property tax, which I think is in real trouble, it will take certain kinds of approach. If it's something that is to be communicated and has to be exercised with some level of the suffrage, certainly the first thing to do is to identify who are the opinion makers in the community. This is sometimes more subtle than will appear on the surface. If it's opinion you want, just in a latent sense that doesn't have to translate itself at the polls, then obviously these may be a whole series of different people. If it is those who may well turn out and have to vote "Yes" or "No" on a measure, there will be a whole range of perhaps different persons. We need to spell out who some of these people are and I think this is one of the research problems that could be explored.

One thing is perfectly obvious in our system, the advantage accrues in the political process, particularly in terms of getting policy established, to the organized. This may sound trite, but it's important. The motivating forces in politics obviously stem from organization. It's true that unorganized interests may set broad limits within which the struggle is channeled and confined, but organization represents concentrated power and concentrated power can exercise a dominating influence when it encounters power which is diffuse and not concentrated, therefore, weaker.

How does one determine the success or failure of organized power? First, all interest groups, no matter who they are, that are going to operate in our system, will find their strength is differentially affected by the political environment in which they operate. In this respect, I'm using "political" not in a partisan sense, but as a definition of being a struggle for power, the attempt to influence policy. Our system provides -- and this is an advantage to all groups if they seek to organize themselves -- a congenial atmosphere to the notion that it's all right to organize and try to get your interest expressed. Some obviously are more able to organize than others, but in general this gives a good optimistic frame in which to operate. As Madison put it, "Liberty is to faction what air is to fire."

Secondly, and more important, the formal organization of government in the United States has an enormous effect on the tactics and strategy of the interest groups. There are, at least, three levels of government and there is a separation of powers and checks and balances. Consequently, there are many points in our system at which governmental policy may be influenced and the converse of that is that there are many points where certain kinds of policy can be blocked. The important point here is that while we said water pollution control is virtuous, if you are going to introduce certain policies which are going to influence the operation of a plan involving the expenditure of money, certain resistances will build up. The opposition will have an initial advantage in that, if governmental action is going to be required, there are many specific places along the line at which they could block the action. Our system provides, then, this opportunity for those who are organized to not only strike once but opportunity knocks over and over at every level.

There is another problem that's posed for interest groups which demonstrates a fundamental weakness of political parties. If this last national election illustrated anything, it illustrated that crossing of party lines is now becoming a condition that is not confined to the independent West. I think this is increasingly going to be a prevalent attitude, as we have a population that is more formally educated and which more and more moves into the white-collar class. Since political parties are weak and will be weaker, this diffusion of power that is already built into our governmental structure strengthens the efforts of interest groups, blocks undesirable policy decisions, and, of course, the weakness of party strengthens the efforts of these same groups to promote the desirable policy decisions they want.

Now, how successful any particular interest group may be could possibly be built around the following factors, the most important of which may be status. Obviously, those groups which attach themselves to the more prestigious aspects of our society are going to have more access to the influentials -- more access to certain agencies that make policy, and certainly more access to money. I would think, for example, that if one is seeking to have a given water pollution program adopted that involves influencing a range of public opinion within an area, one of the first things to do is to create a citizens' committee composed of people who are not only prestigious in their given profession or activity, but also are concerned with things other than just their own axes to grind. For those of you familiar with this area, the late E. B. McNaughton is the kind of person I have in mind. Here was a gentleman who though he was one of the most important bankers in the state of Oregon was also the National Chairman of the American Civil Liberties Union. That's a combination that probably isn't too frequently found. There are a surprising number of people who can take the initiative in trying to present this matter of pollution control as a desirable policy. It is important initially to have the help of those who leave the right impression and whom people have reason to trust and respect.

Certainly, the objective of the interest group must be an important one and, if it is one having a single-purpose objective, particularly with a high moral tone, it has an advantage. As we look at the history of interest groups, there was never one that was more significant politically for a period of time than the Anti-Saloon League. It was an enormously effective organization largely because it had only one concern -- booze. There's a clue here from which we can learn. This effort was enormously successful because it didn't diffuse itself with a lot of overlapping objectives. It just concentrated on one single objective and it was one that was able to cross a number of geographic and even economic lines. Certainly this is an advantage that would accrue in trying to set up some concerted action in the matter of pollution. Here is obviously a high moral tone.

Perhaps the biggest single problem with a program designed to attack this problem of water pollution is that it is going to involve certain kinds of seemingly economic deprivations for certain kinds of industries. For instance, it may be in conflict with the tremendous, concerted promotion that is going on in Oregon, as we witnessed in the last campaign, of attracting industry. I'm reminded of a campaign that was recently held in this area. The Commission of Public Docks wanted to get a bond issue passed to improve the dock facilities here. Some of the officials asked me where they might possibly work best. I said, knowing the voting data to date, "Forget the high-income area. Work the areas that are relatively the lower income. But don't just work them. Find an identification for those folks. Have, for example, the longshoremen and their wives go from door to door in those areas and communicate that this provision means dollars in their pockets. This might be able to overcome this traditional tendency to vote 'No' to revenue measures." The campaign slogan was "Docks Mean Dollars." In this they had a fair amount of success.

To put the argument that here is an attempt on the part of public policy to intrude upon the legitimate operations of attracting industry on the defensive, I would simply ask questions: "Do you really want to pollute water in order to get dollars?" "Do you really want to violate people's health?" There is some validity in asking these questions.

In 1948, in the state of Maryland, Senator Miller Tidings, a very conservative multimillionaire, was running for re-election. Traditionally, Maryland was a Democratic state. The Republicans understandably had the problem of trying to find attractive candidates to run against a sure thing. Finally they settled on a gentleman named Butler whom nobody knew anything about. They felt that this might be an advantage. However, it posed the problem of getting him known. So they brought in a person named Jonkel who had had spectacular success selling breakfast food. Since they felt that he had certain talents in the area of "selling your package," he was obviously the "logical" choice for the campaign! There had occurred previously some charges by McCarthy about some communists in the State Department -- and Tidings, unfortunately, for his purposes at this time, was Chairman of the Foreign Relations Committee, which was charged to explore this claim. So, Mr. Jonkel talked to taxi drivers, elevator operators, and bar tenders and asked them two questions: "What do you think of John Butler?" and he found, not too surprisingly, people didn't know who Butler was and had no attitude or opinion about him. Secondly, he asked, "What do you think of what Tidings has done about the communists in the State Department?" Again he found that most people didn't know if Tidings had done anything. So, the campaign was waged on these two themes. Over and over he used brief spots on the radio to say, "B for Butler." There was a whole series of solemn pronouncements over the radio, "What has Senator Tidings done about the communists in the State Department?" Later Jonkel had the effrontery to say, "I never said there were any communists in the State Department. I never said he didn't do anything about it." It's true -- he didn't. Now, I'm not saying that we ought to adopt quite these gutter tactics, but if they succeeded with that sort of thing, possibly there are some lessons to be learned that could be used in reverse and for positive purposes. I have a friend in the public relations business who says that he always starts with this fundamental concept: "Never underestimate the people's ignorance." I'm not that cynical, but the fact remains that if you want to look at one of the most successful campaigns of all in terms of influencing attitudes and opinions, read the campaign of Whittaker and Baxter on Medical Care back in 1948. The polls had shown that there was a fairly favorable majority to this general notion. It is of interest to note the tactics that were employed in this campaign to defeat the measure. One of the things seized on early was that while public opinion polls indicated that a lot of the people had a certain sympathy about the problems of the aged and medical care, many were opposed to socialism. This public attitude has been used with relative success on the part of the medical profession since then. As evidence, note the ads that appeared recently in the Reporter Magazine among others. A very tragic picture is painted of a chap who is behind the wall in East Berlin. A person cannot help but have sympathy for that pathetic situation. The heading is, "How Is Freedom Lost?" And, "Dangers that grow within our borders can string barbed wires around our freedom as tightly as dangers that come from abroad, but they aren't as easy to see. Some of us are hardly aware of the threat that grows within." And, on with the message. The sponsors, "Your privately-owned utilities," of course, then suggest that the erection of such dams as Bonneville and Grand Coulee are the "subtle way" in which we are losing our "freedoms." The particular message may not be applicable, but you can well anticipate that if certain economic interests feel that policies of pollution are going to have an adverse effect to their interests, they will try, if Government can be attached to it, to give it the theme of socialism. And if those kinds of popular themes are going to be used, why not anticipate them and put those kinds of charges immediately on the defensive? If you ever let them put you on the defensive, the campaign will be lost. I'm not sure that all these tactics would seem to us to be appropriate or proper, but there is a certain problem of pragmatism here as well.

I have tried to make suggestions as to some of the general problems of interest groups and the problems of attempting to influence public opinion. I would think that as you move toward trying to translate your research into concerted policy or public action you will necessarily have to disabuse yourselves of the idea that the validity and integrity of your material will necessarily translate itself into (1) a communication, and (2) a conviction. It will be necessary to bring in other groups within the community, to get them to champion this cause, to get them to communicate to those who have the most prestige, and, if it does move into the area of having to have it on the ballot, be aware that there are enormous problems posed if matters of revenue are involved. I feel that all the advantages previously indicated are true. It is particularly arresting that while public opinion may not itself be able to initiate action, it does set the outer limits. I conclude by a recent illustration of this. There was every evidence that measures to strengthen the Pure Food & Drug Law in the last session of Congress were dead. I happened to be back in Washington at the time and everyone I talked to said, "It's dead." Then there was that very tragic, dramatic episode - Thalidomide. Something happened and the issue suddenly became alive.

I would suspect that if anything is dramatically and effectively done about the problems implicit in water and air pollution, it may well have to approximate something of this type. That is, that it needs to be sufficiently dramatic and sufficiently effectively communicated and yet never to the point of exploiting hysteria.

You've many groups latently working with you. One group may well be those involved in health food organizations. These people are part of a crusade -- it is a liturgy, a litany, a gospel. It is possible that that group could be one of the missionaries to move against water pollution. They have a following that is more than regional, or local, and they have been a group that has been most concerted in their concern about our keeping our pure water. So, if there's anything positive that can come out of repeated refusal to eliminate tooth decay, it may well be that here are groups that can be used to give a positive contribution to our water pollution problems.

SOCIAL AND ECONOMIC ASPECTS OF THE RELATION OF LAND USE TO WATER QUALITY

William E. Bullard*

Integration of Land Use and Water Resources

Surface water supplies are collected on and drawn from watersheds, and most groundwater supplies were once collected on and percolated through watersheds. The function of the watershed depends on its ability to catch, hold, store, and release water. Watersheds with deep soil supporting a dense vegetation cover will catch and filter and store and slowly release fairly great amounts of rainfall. Barren watersheds with degraded soil and little or no cover produce flashy sediment-laden runoff from every rain, with no storage to be slowly released later.

Between the two extremes are most of the watersheds used and developed by man. The use and development affects the cover and the soil. Natural cover may be replaced with crops of various kinds; the new artificial cover is rarely permanent, but varies from season to season in type and density. Over considerable areas, the cover may be cleared away for roads and buildings and replaced with paved impermeable surfaces which act like the barren watershed. And in some areas, the type of natural cover may be changed to cut down its draft on water so that more water is available for use in lower parts of the watershed.

Development and use of watersheds affect water quality as well as volume of production. Removal of cover and disturbance of soil lead to erosion on the land and turbidity and sedimentation in the water. Growing crops involves fertilizers and pesticides; some of these get into the water draining the land. Irrigation waters also leach out excess natural salts from the soil; these, too, affect water quality. Machines on the land provide spills of oil and gasoline that may move into streams. Mining often brings unwanted elements to the surface where they contaminate water supplies. And worst of all, the streams may be used directly as carriers to remove industrial wastes and domestic sewage.

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*Forester, Watershed Management, U. S. Department of Health, Education and Welfare, Public Health Service, Division of Water Supply and Pollution Control Program, Pacific Northwest, Portland, Oregon.

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It would appear that one cannot touch the watershed without touching the water.

Social Values in Multiple Use of Resources

Multiple use of resources is necessary to a society facing limitations on new worlds to conquer. When we had much land and few people, we did not worry about multiple use. There was no need and no pressure. We dumped our wastes in the river and went upstream or to another stream for drinking water. Now there are few untapped streams, few rivers that don't support another town upstream, few areas of land that can be left to single uses. All land is watershed, in addition to whatever else we may use it for. And whatever we use it for will affect the water produced from it. If we want controlled production of high quality water, we must make allowances for it in our use of the land.

Water quality controls both public health and industrial development, and therein lie its specific values for society. High standards of quality are demanded for domestic supply, for some industrial supply, for recreation use. Somewhat lesser, but still fairly high standards are demanded for irrigation use. For navigation, it is demanded only that water be of such quality as to float boats and barges without rapid corrosion. But for waste disposal, it is not a matter of quality, only that the water move fast enough to carry the wastes out of sight, out of smell, and out of mind.

Aquatic habitat in good condition also has values for society. It is the source of desirable protein food and the locale of much of our outdoor recreation. As the aquatic habitat changes from its condition in nature, it becomes less and less able to support desirable life forms, and less and less desirable for recreation activities. Too high temperature, too much sediment, too many nutrients, too great a load of toxic elements -- any of these things that may occur following development of watershed lands will radically change a stream or lake environment and destroy its utility. Condition of the aquatic habitat is an indicator of water quality in the habitat.

Economic Considerations

Multiple use of land and resources from the economic standpoint is brought about by the needs and demands of more and more people applied as an ever-increasing pressure against the same base. As these needs are translated into values or amounts of money bid for resources and uses, it soon becomes profitable and eventually necessary to double up on production and use. The timber harvest, forage harvest, and certain forms of recreation use on forest land are largely compatible and can be had more or less simultaneously from the same acre. When the demands are great enough and diverse enough, multiple use happens. Until then, the dominant economic group among the uses -- and often the only group -- will operate on a single-use basis; mining here, grazing there, timber harvest somewhere else.

On the single-use operation, there is little or no attention given to protection of other uses. A watershed is grazed for forage; no one is concerned that the grazing use results in soil compaction and soil erosion that lead to flash floods and sedimentation and turbidity in the streamflow produced on the area. All the water of a small stream is diverted for mining; no one is concerned with the destruction of aquatic habitat in the stream. Only when development and demands of all kinds seek satisfaction is there interest -- backed by economic advantage -- in protecting the watershed used for grazing or in safeguarding the aquatic habitat in the stream used for mining.

Perhaps the finest current example of economic consideration -- or lack of it -- with regard to water quality is that of highway construction. Too often the location of the highway, the amount of soil disturbance initiated in construction, the lack of stabilization of exposed soil, the use of streams as dumps for excess materials, all indicate that the only objective is the shortest route for the least money and to hell with the landscape, streams, fish, etc. It is cheaper to build along a stream channel than on the rougher topography above; it is cheaper to dump excess soil and rock over the edge into a stream than to endhaul to a cove or bench for safe disposal; and it is cheaper to do without temporary culverts and operate in the stream than to take precaution against disturbing the channel bottom or blocking the stream. Stabilization of cuts and fills is costly, and therefore often omitted. Proper drainage disposal is expensive and therefore often ignored. Every single omission in any of these cases reacts to the detriment of water quality and decreases the amount of available water or increases its cost for downstream users.

Recreational value of water can be reduced or eliminated by suspended sediment which reduces the visual appeal or affords safety hazards. Organic waste loads may reduce dissolved oxygen below levels needed for fish survival, or toxins may kill fish directly or remove their food source. Sediment may interfere with one phase of the life cycle and so remove fish populations.

Dissolved minerals from mines or oil wells may completely sterilize a stream and make it totally unfit for any use. Since it is generally felt that water used for recreation by the public must be clean and attractive, maintenance for future recreation will comprise a major part of pollution abatement programs.

Evapotranspiration and leaching increase the salinity of streams receiving irrigation return flows in heavily irrigated areas. In fact, irrigation in arid regions is often used as much for salt removal as for water supply. Yet, the high level of salinity built up in the streams degrades the water for subsequent agricultural use, for most industry, and for recreation.

Silt pollution is a major handicap to effective development of water resources in many river basins. Some six million acre-feet of water each year must be filtered to remove silt at a cost of more than two hundred million dollars. It is estimated that the rivers of the United States carry a billion tons of sediment to the ocean and deposit three billion tons in reservoirs and on valley lands and in harbors each year. The principal source lies on agricultural lands, but urban construction has become a significant silt source. We may expect increased silt loads in the future as intensity of agriculture is increased and urban expansion continues. The damages by silt pollution include the cost of water treatment, reduction of streamflow velocity, destruction of wildlife habitat, reduced recreation opportunity, cost of dredging, loss of reservoir capacity, increased flood hazards, reduction of drainage system capacity, and degradation of water quality.

Land Use and Management Practices

The practices that significantly affect water quality will vary from one class of land to another. On forest land, they will be primarily those associated with harvesting the timber; on range land, those associated with grazing animals, etc. But within each class, there are different methods applicable, with varying effects on water quality.

Logging on forest land if done by highlead cable systems will cause less soil disturbance and erosion and sedimentation than if done by tractor. A "skyline" system will cause still less trouble and demands less in the way of access roads. Yet even tractor logging done carefully with the lightest equipment capable of doing the job, restricted to dry weather and to lesser gradients, need not cause excessive or intolerable soil disturbance. Properly designed layout of the cutting areas, location of landings and haul routes, scheduling of operations, control of equipment use, and cleanup after the job will obviate most of the problem situations. Eventually, we may see such major changes as the advent of helicopter logging which would still further reduce the need for any soil disturbance. It is already economic in some cases in some parts of the world.

Grazing domestic stock -- principally sheep and cattle -- on open range leads to considerable land abuse. Competition for forage on public lands results in over-use, destruction of cover vegetation, compaction of the soil, sheet erosion, flashy runoff, gullying, floods, and sedimentation. Nor does the productivity for forage remain high under such conditions. Controlled use of the range, putting on numbers of stock compatible with the amount and condition of the forage, restricting season of use to avoid damage to soil and plant cover and to permit natural regeneration -- all will help avoid damage to the range itself and to the water flowing from it. Yet unrelated factors have brought about the greatest changes: difficulty of hiring herders during the war led many livestock operators to put their stock onto irrigated pasture; having done so, they found they could raise more pounds of meat at less cost and more rapidly than on the open range. Where land is available for the conversion, the trend is away from use of open, undeveloped range.

Pesticides are a recently greatly expanded pollution factor on forest and range lands, though they have been used for more than a century on croplands. Now we have over twelve thousand brand-name formulations and more than two hundred basic control compounds on the market, with three billion pounds sprayed over more than one hundred million acres each year. These pesticides are estimated responsible for at least half of the fish kills reported around the country, and some of them are known to have killed birds and mammals. It is possible that they are contributing to the rapid rise in cancer noted over the last fifteen years. Damages from pesticide pollution include immediate loss of wildlife, damage to wildlife habitat, weakening of wildlife populations and lowering their reproductive capacity, as well as the threat to human health. Recreational and aesthetic value of wildlife is generally considered far more important than the estimated multi-billion dollar tangible economic value; while the losses may only locally be serious, any loss is significant in the eyes of many people.

Crop production usually involves various kinds of cultivation of the soil, application of fertilizers, water, pesticides, and weedicides. Any of these operations can create serious water quality problems. Cultivation removes cover, exposes and churns up the soil; erosion is a constant hazard. Along with soil particles lost by erosion are portions of the fertilizers and other substances applied to the soil that are washed away to streams. Total impact on water quality is tremendous. But conservation farming with cultural methods designed to hold the soil in place can reduce sediment contributions to insignificance; other pest control methods in some cases can reduce the need for and hazard from the various chemical killers; and judicious application of fertilizers can reduce nutrient movement to streams. However, where irrigation is used -- as it is in many arid regions -- specifically for the purpose of leaching salts out of the soil and flushing them into the rivers, there is not much hope for future improvement of water quality by means of changes in land management-use practices. Whether use of such land and such use of water is continued or abandoned is a decision that must be made by all the people affected.

Problems involved in highway construction have already been mentioned. They can be avoided in part, at least, by careful location of routes relative to local topography and soil conditions, and by modification of certain construction practices. Whether or not the modifications are "economic" from the standpoint of highway construction is beside the point; however, the method that protects water quality will often prove cheaper for the highway, too. It is quite possible for the consumer to have both a good transportation network and adequate water quality; there is no immutable law of nature that requires sacrificing the one for the other.

Some forms of mining disturb large areas of land and so may be considered a "land use." This would include stripmining, hydraulicking, and dredging. In the Lake States, stripmining for coal is widespread and has affected water quality draining many thousands of acres. Silt is only part of the problem; worst effects are those of weathering and breakdown of pyrites to form sulfuric acid that destroys the aquatic habitat and the utility of the water in the streams. Untreated spoilbanks erode to contribute silt, but it usually is the lesser problem. Hydraulicking and dredging put the disturbed soil directly into the stream; fortunately, neither process is widely used nowadays, and both are subject to restrictions when used. Only gravel dredging from stream channels remains a widespread practice that often has deleterious effects on aquatic environment and quality of the water for downstream users.

Developments on the streams themselves have significant effects. Dams may trap sediments coming from upstream, but initiate a cycle of channel cutting and sediment reworking downstream. Levees and diversions may initiate a chain of bankcutting, channel meandering, bar removal, and redeposition of sediments. Impounded water may become warmer, may stratify and become depleted of oxygen, and may develop algal growths that upset the balance in the aquatic habitat and lead to taste and odor and other quality problems. Dams also may cut off fish passage and destroy fish populations as well as modifying their habitat.

Land Rehabilitation

Abused and degraded terrains contribute flashy flows of silt-laden water to streams. The principal pollutant is silt, and the seasonal distribution of the water provided is sufficiently variable to reduce still further the usefulness of the supply. From the water management standpoint, correction of the situation on eroded abandoned range and cropland and repeatedly burned forest is as much a matter of improving the flow regime as it is of reducing the sediment load. But both are important to water quality management.

From the economic aspect, rehabilitation may not appear desirable. It costs too much, and the productive capacity to be regained is not worth the effort at present evaluations. However, from the long-term social aspect, which would include anticipated distant future changes in need for food and fiber as well as control of floods and sedimentation and provision of greater amounts of usable water in regular supply, it is not only desirable but imperative.

Rehabilitation is possible. Denuded forest areas can be seeded and planted and brought back to conditions favorable to control of water and to production of other forest values. Degraded range can be repaired with terraces and gully plugs and reseeding and fertilization and be protected until a good new cover is established to afford control of runoff and to provide good wildlife habitat. Abandoned, worn-out cropland can be made productive again with similar measures designed to stop erosion, provide a plant cover, and improve soil structure.

After the watershed lands have been given back their regulatory influence on streamflow, the streams, too, can be rehabilitated. Sliding or undercut banks can be stabilized with structures and vegetation; channel blocks can be cleared away. Release of impounded water can be made for flow regulation, for temperature control, or for habitat control in the reservoir itself.

Nationwide, the U. S. Department of Agriculture's Conservation Needs Inventory summarizes the situation thus -- and we quote only the parts directly affecting water quality:

> "738,000,000 acres with excessive erosion need conservation treatment; 101,000,000 acres are expected to shift to new uses within twenty years, including a net loss of 15,000,000 acres from agriculture to urban or related use; 8,300 small watersheds need treatment to reduce flood damages. Proposed programs include reduction of erosion losses on 161,000,000 acres of cropland; reestablishment of cover on 72,000,000 acres and improvement of cover on 107,000,000 acres of rangeland; control of erosion on 12,000,000 acres and reforestation of 69,000,000 acres of forest land. Protection against fire on more than 400,000,000 acres of range and forest needs to be improved. Accomplishing these programs will provide more water and recreation facilities."

Summary

We get most of our water supplies from watersheds, and water management cannot be separated from watershed management. Integrated planning and integrated management are necessary; any use or development on a watershed may have serious effects on water produced there. All the desired uses or products of the watershed must be considered together with their interactions in designing management and setting limitations. Occasionally, the limiting factors are economic, but more and more social necessity may override economics. To meet long-range social needs, there is a considerable land improvement program recommended which will greatly aid water quality management. A major difficulty in solving pollution problems is that the damage done is generally external to and does not directly involve the source agent or operation causing the pollution.

Finally, it should be the objective of land management never to neglect and always to include consideration of impacts on water resources of any operation on the land. Essential to reaching this objective then are maintaining optimum conditions of streamflow and aquatic habitat by guarding against diminution of the regulatory effects of soil and plant cover on the watershed and against adding any polluting material regardless of the beneficial intent.

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DISCUSSION

Q. Do you think that the current programs which are provided for small watershed treatment are properly designed to handle watershed problems effectively?

A. I worked on that program for some five or six years here in the Northwest and it is my feeling that the operation under the law, as it is written, does not permit us to do what many of us feel should be done on the land. It doesn't fit our conditions. The law was written by Mid-westerners and it fits their conditions very well, but we are not gaining much from it in the Northwest.

Q. Is this an area that should be examined carefully in terms of research projects?

A. Yes, but when these projects go to Congress to determine priorities, the priorities seem to depend pretty much on two things: (1) the cost, and (2) the number of people involved and interested. So far, we do not have the people pressure developed in the Northwest that they have in the Mid-west. This is one reason why we do not have a law which fits our conditions as well as theirs. I doubt if we can do much about it until we get more intensive development out here and more demand for it. The need exists and should be explored, but I doubt if it will be done in the near future.

Q. Some time back I recall reading an article on irrigation practices in Iraq where they collected the underflow from irrigation and re-used it for irrigation in virtually a closed system. What would happen if something like that were practiced here? Would too heavy a chemical load soon be developed?

A. I think it would in most cases.

Q. What about the loss of fertilizer elements?

A. The losses of fertilizer can be controlled by the timing and scheduling and by the method of application, as well as the amount applied, so that what is put on the land stays there bound up with the soil particles, or is extracted by the plant roots and does not leach down into the groundwater or runoff. Sometimes the farmers are careless in their application and fertilizers leach out and become excess nutrient in the streams.

RELATIONSHIP OF WATER QUALITY TO MULTIPLE-PURPOSE WATER RESOURCE DEVELOPMENT

Donel J. Lane*

There is a long-established premise in fact and law that the waters belong to the public and that individuals or other entities have a right to use, not a right to own. Under this premise there have developed two entirely different methods of administration and allocation of water.

Under the riparian doctrine, historically recognized by the eastern states, individuals have a right to utilize the waters flowing by lands as long as that use does not substantially diminish either the quantity or the quality of the water.

The concept of administration of water in the western states resulted from necessity. The early pioneers moving west of the Mississippi, and ultimately into the Pacific Coast states, were primarily in search of gold and lands to provide food and other forms of sustenance for their families. They found, upon arrival in most of the western areas, that water was necessary to extract the gold; that water was also necessary to raise crops and provide forage for their livestock. In most cases the water was physically separated from the minerals or from the land area desired to be utilized. This necessitated transporting water from its source to the point of use.

Since water was not in abundant supply at all times of the year for all users, a system of determination of rights to use had to be developed. This system is termed the doctrine of appropriation. Its implementation conformed to the procedures of the times. In many states claims were posted at points of diversion of waters similar to the early posting of mining claims. Later a more formal procedure was developed wherein statements were filed with the territorial officials and ultimately with county officials stating that as of a certain date John Jones used a given quantity of water for a certain purpose at a defined point.

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*Executive Secretary, Oregon State Water Resources Board, Salem, Oregon.

In Oregon this procedure was formalized in 1909 when the state adopted its Surface Water Code and established the office of State Engineer to administer that code. This 1909 Act states the previously established premise that all waters from all sources of supply belong to the public; further, that the water may be used for beneficial purposes without waste providing applications are filed with the State Engineer, procedures are set out for the issuance of permits, and when the water has actually been put to the use proposed, a certificate is issued. Procedure was also established for determination of rights to use water that existed prior to the 1909 Act. This is our adjudication proceeding which involves an elaborate form of notice, hearings, a determination by the State Engineer, and finally a decree by the circuit court. Similar proceedings are in effect in most western states.

The system of appropriation defines by statute beneficial uses and has historically established that first in time is first in right. In making an application for a right, not only the point of diversion and the amount must be stated but also the use. Our applications were in most cases single-purpose. In the earlier years, beneficial uses of water were confined to the so-called consumptive beneficial uses including domestic, municipal, irrigation, manufacturing, and the so-called nonconsumptive use of power. Several western states have constitutional or statutory priorities of use.

While the advent of storage developed in the latter part of the last century, it was only in the last three decades that significant consideration was given to the multiple-use concept of water resource development. A major factor in this was the enactment by Congress of the 1936 Flood Control Act which gave to the Corps of Engineers the responsibility of developing plans and constructing major flood control projects and an acceptance of flood control as a national responsibility. Under the authority of this Act, we had developed, later authorized, and at the present time have under construction, the Willamette Basin Project.

Recognition of water quality as a project use is shown in House Document 531, 81st Congress, 2nd Session, wherein certain flows of the Willamette River are defined as goals for water quality purposes although no quantities of storage are allocated for this purpose even though benefits were assigned. It should also be pointed out that these waters also provide navigation benefits. While project waters can be used for water quality purposes, the importance of this use must not have been considered too great inasmuch as no provision was made to insure that the waters remained in the stream for the purpose for which they were intended. In a case such as this the waters can be released from a project for water quality maintenance and yet in most states that water is subject to appropriation by downstream users.

The basic water policy of the State of Oregon is that pollution should be treated at its source rather than utilizing the waters of the state for dilution purposes. For example, ORS 449.105 states, "No persons shall put any dead animal carcass or part thereof, excrement, putrid, nauseous, noisome, deleterious or offensive substance into or in any other manner befoul, pollute, or impair the quality of any spring, river, brook, creek, branch, well, irrigation drainage ditch, cistern or pond of water which is or may be used for domestic purposes or to which cattle, horses or other kind of domestic stock have access."

In ORS 449.107, "Persons on land within 100 yards of any stream, lake, reservoir or pond or channel thereof, and not having a possessory interest in such land, shall not throw, discard, or leave trash, rubbish or debris other than in receptacles provided for the purpose of holding such trash, rubbish, or debris."

ORS 449.110 states, "No person, or proprietor, operator, agent, superintendent or employee of any railroad company, sawmill or other lumber or manufacturing concern, or any pulpmill, woodsaw, tannery, woolen mill, dye works, gravel crushing or washing operation, chemical works, slaughterhouse, or any manufacturing concern, or any steamboat or any other water craft shall cast or suffer or permit any sawdust, planer shavings, wood pulp, or other lumber waste or any element or chemical extracted therefrom, or any unclarified wash water from gravel crushing or washing operations, or other substances, which do or may render the waters of a stream or any other body of water destructive of fish or aquatic life, or any slashing of trees or brush, or any oil, coal tar, petroleum or extract therefrom, or any dye or chemical to be thrown, cast or discharged, in any manner, or to deposit the same where high water will take or carry same, into the waters of this state."

ORS 449.115 states, "No person shall put or deposit in any of the rivers, streams, lakes or waters of Oregon, or any artificial canal or ditch in which the waters of such rivers, streams, lakes or waters run, any dead animal carcass or parts thereof, manure, sewage, putrid, decaying or deleterious substance, refuse, waste or polluting matter, or any matter which either by itself or in connection with any other substance injures fish or corrupts or impairs the quality of the waters of such rivers, streams or lakes for domestic or municipal purposes, or place any such substance in such position that it escapes or is carried into those waters by the action of the elements or otherwise."

ORS 449.125 states, "No burying ground or cemetery shall be established on the watershed of any public water supply nearer than 500 yards of the source of supply."

ORS 449.130 states, "No person, firm, corporation or municipality shall flow or discharge sewage or waste water above the intake of any drain, brook, creek or river from which a public drinking water supply is taken, unless it has been passed through some well known system of sewage purification approved by the State Board of Health."

ORS 449.134 states, "All schools, hamlets, villages, towns or industrial settlements which are located on the shed of any public water supply, not provided with a sewage system, shall provide and maintain a reasonable system approved by the State Board of Health for collecting and disposing of all accumulations of human excrement within their respective jurisdiction or control."

And possibly in the event that the foregoing sections were not inclusive enough, the Legislature adopted ORS 449.120 which provides, "No person shall wade or bathe in any irrigation canal, ditch or flume which supplies water for household purposes, except for wading done in connection with the operation, maintenance, construction, distribution or maintenance of water."

If we accept the concept that waters can be used as an alternate for treatment - if we accept the concept that dilution is the solution better than treatment at the source - if we accept the concept that the solution to our water quality problems is merely to put more water into the streams - we are in for trouble. It is my belief that we should operate on the basis that our waters are used for pollution abatement by sufferance rather than by design. This is the firmly established policy of the agency that employs me, the State Water Resources Board.

The 1955 Act creating the board established the multiple-use concept of water as state policy. Section 1 of the Act, in part, states, "A proper utilization and control of the water resources of this state can be achieved only through a coordinated, integrated state water resources policy, through plans and programs for the development of such water resources and through other activities designed to encourage, promote and secure the maximum beneficial use and control of such water resources, all carried out by a single state agency." Subsection (2) of Section 1 states, "The Legislative Assembly therefore finds that it is in the interest of the public welfare that an integrated state water resources policy be formulated and means provided for its enforcement; that plans and programs for the development and enlargement of the water resources of this state may be devised and promoted and that other activities designed to encourage, promote and secure the maximum beneficial use and control of such water resources and development of additional water supplies be carried out by a single state agency which, in carrying out its functions, shall give proper and adequate consideration to the multiple aspects of the beneficial use and control of such water resources with an impartiality of interest except that designed to best protect and promote the public welfare generally."

A basis for the Act was conflict in use because the Legislature also said, "The economic and general welfare of the people of this state have been seriously impaired and are in danger of further impairment by the exercise of some single-purpose power or influence over the water resources of this state, or portions thereof by each of a large number of public authorities and by an equally large number of legislative declarations by statute of single-purpose policies with regard to such water resources resulting in friction and duplication of activity among such public authorities, in confusion as to what is primary and what is secondary beneficial use or control of such water resources, and in a consequent failure to utilize and control such water resources for multiple purposes for the maximum beneficial use and control possible and necessary."

A factor in creating these conflicts was the quantity depletions resulting from diversions for beneficial use. My earlier reference to trouble arising from acceptance of utilization of dilution as a solution to our pollution problems rather than treatment at the source was based upon my firm belief that water quality deterioration can have the same effect on other uses as does a direct diversion from the stream. From a practical standpoint, lowered water quality can result in economic and physical prohibition on other users.

Before we accept the assignment of benefits in projects for water quality purposes and specific assignment of quantities of storage and releases, we need to develop adequate quality criteria. The basis of the benefits assigned in House Document 531, 81st Congress, 2nd Session, was to maintain five parts per million dissolved oxygen in the Willamette River. This criterion apparently was aimed at maintaining satisfactory water quality for fish. Is this the only criterion needed to establish satisfactory water quality? What about chemical pollutants? We have a national awareness of the possible effect of insecticides and pesticides on water quality. We have an increasing problem resulting from the accelerating use of detergents. Should not these factors be considered in developing water quality criteria particularly as related to multiple-purpose projects?

With the ever-increasing demands for water, we are going to be using our waters many times for as many purposes as possible. We do not have sufficient water available to permit the first users to pollute the waters to the detriment of downstream users. It is our belief that the waters are too valuable for use for other purposes to be committed to a single use or abatement of pollution.

Can our waste waters be utilized for other purposes? Or are we going to be committed to acceptance of water quality as probably the major consumptive use; consumptive from the standpoint that the waters utilized for these purposes are not available to other users?

In this connection I believe that we need to intensify the research to determine whether the waste waters from municipalities and industries, after satisfactory treatment, can be used for other purposes. I refer specifically to the studies currently underway with respect to utilization of waste waters from municipalities and industrial plants for irrigation purposes. If this type of use can be developed, it will open the way for major industrial opportunities in many parts of Oregon where the streamflows are inadequate to provide the water needed for existing and future uses and carry away that portion of the waste which cannot be effectively treated. The findings of such research may well minimize or eliminate one of the major conflicts resulting from utilization of flows for pollution abatement. It is our hope that this type of conflict can be resolved on the basis of economic benefits to all concerned rather than being forced to choose between economic alternates. The answer to this problem lies with the technical people. They should be properly funded and put to work. I believe the state has an obligation to participate in this type of research. The state has a firmly established policy to maintain water quality. The state also has a firmly established policy of inviting and urging major water-using industries as well as other types of industries to locate here. We should take the lead in providing feasibility standards to show industry how it can live profitably with our water quality standards.

The resolution of possible conflicts in multiple-purpose use, particularly with respect to water quality, can be resolved, I believe, if planning agencies and those allocating benefits concentrate on developing criteria for determination of water quality requirements commensurate with other beneficial uses of water. In the State of Oregon, beneficial uses include domestic, municipal, industrial, irrigation, power development, mining, recreation, wildlife and fish life purposes.

Standards must be established high enough so that the assignment of water quality benefits does not preclude utilization of waters for other purposes. We recognize that each water development must be studied within the framework of its own particular problem area, that all needs of the area should be considered not only for present but future uses including water quality control. Greater project benefits and greater benefits, of course, to the nation are achieved when all possible project uses are included. The basic goal in water resource development that should be kept in mind is to make water available for as many purposes as possible commensurate with the needs of the area and it, of course, imposes an obligation to maintain quality standards commensurate with all uses. Criteria for water quality benefit allocation should not be based solely upon the requirements of aquatic life, but rather this plus the needs of the industrialist, the irrigationist, the municipality, the recreationist, and the individual domestic user. The recently authorized Corps of Engineers' project, Rogue River Basin, provided a basis of attaining major benefits for fisheries. Studies and evaluations made a part of the report indicate that the Lost Creek Project, particularly, will be operated to release major quantities of water (up to 2,000 cubic feet per second) to increase downstream flows and lower water temperature. While the benefits are directly assigned to fisheries, the result will be improved water quality for downstream users.

It may well be that we may be forced into the situation wherein the waters of certain streams of the nation will have to be set aside merely for the transportation of pollutants. It is our goal and our hope that as a general rule this will not be necessary but that adequate treatment can be provided at the source on both an economic and physically feasible basis so that waters could be made available for all the uses.

I cannot in good faith recommend the allocation of water for pollution control other than on a temporary or emergency basis. The need is for continued research and continued development directed towards methods of determining physical and economic methods of treatment with the result that water will be allocated for other purposes and that water quality control will be a by-product of these uses rather than the primary motive.

I am not too concerned with the economic legerdemain necessary to develop a benefit-cost ratio for water quality control but do recommend that it be on a basis other than alternate cost. Municipalities install sewerage systems not on the basis of the benefit-cost ratio but rather on the basis of compliance with the public policy. This, I think, should be kept in mind in any allocations or suggested allocations of water for water quality purposes.

I advocate that the absolute minimum flows acceptable and utilized for quality control should also meet the needs of recreation, wildlife, fish life, navigation, and other purposes. We do recognize that certain minimum flows are necessary to maintain satisfactory stream quality because of residual and uncontrolled pollution. Benefits for this purpose may properly be a condition of the project. At the same time it is the position of the State of Oregon that water should not be allocated for pollution abatement in lieu of adequate treatment. The emphasis should be on treatment rather than dilution.

While I have not seen any final recommendations with respect to allocation to water quality benefits, I have received preliminary information that arbitrary assignment of six parts per million of dissolved oxygen has been utilized as a standard. The basis for this is unknown but it is assumed that it is adopted because it is on the safe side of five. The five parts per million in itself is more or less a number picked off a sky hook. I believe that conflicts presently existing can be resolved if we keep concentrating on the primary goal; that of eliminating the pollution at its source through adequate treatment, rather than accepting as an alternate the utilization of our water resources as a dilution mechanism.

There are many legal problems involved in solving this problem. Oregon is one of the very few states, if not the only one, that recognizes pollution abatement as a beneficial use of water. However, the authority to allocate water for pollution abatement is jealously guarded by the State Water Resources Board. In its basin investigations to date, covering more than one-half of the geographical area of the state, the board has not seen

fit to allocate unappropriated water for this purpose. The board has said in its orders that water rights for industrial and mining purposes shall be granted only on condition that return flows or effluents from such uses do not interfere with other beneficial uses of water. The board's position has been in each of the areas studied that the water is too valuable for other purposes to be utilized to dilute pollution in lieu of adequate treatment.

DISCUSSION

COMMENT: There has been an inference or an interpretation by some people that the amendments to the Federal Water Pollution Control Act advocate reservoir storage as a substitute for treatment. Such is not the case. In fact, the Act is very specific and says: "In the survey or planning of any reservoir by the Corps of Engineers, Bureau of Reclamation, or any other federal agency, consideration shall be given to inclusion of storage for regulation of streamflow for the purpose of water quality control except that any such storage or water release shall not be provided as a substitute for waste treatment or other methods of controlling wastes at the source." We all know that so far we cannot treat our wastes 100 per cent and it very well may be that providing water for dilution is an interim measure to satisfy present-day needs and will insure that this water at a later date will be available for other beneficial uses. There are wastes that are not subject to treatment -- for instance, the pesticides and insecticides and some of the agricultural chemicals. It is impossible so far as science knows today to remove these from the runoff into the stream. Concentrations of these have been found by our nationwide monitoring program to have already reached the point where they are more than detectable. As far as we are able to see today, the only way to protect or restore the quality affected by these chemicals so that the water can be used for further downstream uses is by some flow augmentation during the critical flow period.

Very often this same storage for quality control will satisfy other beneficial uses. For instance, in the Rogue River study for the Corps of Engineers, we found that the requirements for temperature control for the fisheries will also satisfy all the pollution abatement uses. The Public Health Service is fully cognizant that our final objective is to cleanse the waters by maximum treatment. That is one of the principal research activities that the Public Health Service is engaged in at this time. If enough research is placed in the effort, eventually answers will develop. However, if we do not include storage for this purpose in the reservoirs that are being constructed today, with all we can economically do to treat the sewage and industrial waste, we still may have a residual waste from the treatment plant effluents that will lower the quality of water below that which is necessary for certain downstream uses.

Q. Isn't it difficult, in the light of present knowledge, to determine how much water is needed for a project when you are talking about water needed 100 years hence?

A. If we look into history, we find that in anything we have provided in the past, the demand has been greater than what we have supplied. What we provide today in the name of water quality benefits may be needed badly in the future for many and maybe more economic water uses.

Q. The statement was made that good stream water was too valuable to use for diluting pollution. Are there some economic studies to justify this?

A. In many areas the problem is not economic, but physical. What other source do you have than the water which is available? The scarcity places the value. The determination of cost-benefit ratio is not too significant. I do not know of any municipality required to put in a sewage treatment plant on the basis of a BC ratio.

COMMENT: The day will come when we can have all the answers of how to treat our wastes. From the economic standpoint I have engaged in two or three studies where we could show that it was more economical to use the water to replace secondary treatment than it was for power, but under the Act this cannot be recommended because that is not considered adequate treatment in the eyes of technical people.

COMMENT: Five ppm of oxygen for fish is not a nebulous figure plucked out of nowhere by someone guessing. This was an amount that was determined by a fair amount of work to maintain a healthy population of fish. It is not the minimum on which fish will survive.

INTER-AGENCY RELATIONSHIPS IN WATER RESOURCE DEVELOPMENT

Roy W. Scheufele*

This discussion deals with the existing organizations and relationships of those federal, state and other agencies concerned with the planning, development and management of the water and related land resources of the Pacific Northwest. It neither extolls nor deplores the status quo. Literally, millions of dollars and thousands of man-hours have been expanded in relatively recent years in serious and prolonged review and analyses of how the job might better be done, and voluminous reports and recommendations on that subject gather dust on the library shelves. They are of interest apparently chiefly to the student, the researcher, or to someone looking for the basis of a discussion such as this. Those interested will find a partial listing of the studies contained in Committee Print No. 2, 86th Congress, 1st Session, which is a part of the report of the Select Committee on National Water Resources, United States Senate.

The original Hoover Commission reported some twenty-three federal agencies engaged in one or more activities in the field of water resource planning, development and management. Since then several agencies have been added, including the Area Redevelopment Administration and the Bureau of Outdoor Recreation. If the few which do not operate in the Pacific Northwest are eliminated, there are still over twenty. But there are more. The Columbia Basin Inter-Agency Committee recently made a survey of its own to identify agencies concerned with water resources in the states of the Northwest. Of the odd twenty federal agencies I have referred to, twelve had offices in the state of Oregon, nine in the state of Washington, ten in Idaho, and five in Montana. Utah, Wyoming and Nevada are, as of the moment at least, unreported. For details see the Report on Organizations Responsible for Water Resource Planning in the Columbia Basin dated January 11, 1961, prepared by the Comprehensive Planning Subcommittee of the Columbia Basin Inter-Agency Committee. A hopeful new entity is also just over the horizon - the Columbia Compact Commission.

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*Executive Assistant to the Division Engineer, U. S. Army Engineer Division, North Pacific, Corps of Engineers, Portland, Oregon.

Most of these organizations to which I have referred have been in existence many years and each has worked hard to carry out its assigned mission pursuant to its statutory and administrative directive. There was a time when an agency's action ability and vision might have been limited by its specific functional assignment, but I think this is not true today since most have expanded their efforts into multiple-purpose work. Each knows what it does may have a profound effect upon the work of the others, and attempts to ascertain that effect and accommodate it. If we reflect upon what has been accomplished over the years, we can conclude that we have done quite well under the circumstances.

Throughout this discussion I will use the word "coordination" quite freely. I find, too frequently, that the word is not always interpreted to mean the same thing by the "coordinators". We coordinate when we establish an order, or harmonious and reciprocal relationship, in the things coordinated. But it is a hard fact of life that too many of us construe the word "coordinate" to mean "agree" and that, in any effective administration, however closely coordinated, there must at times be decisions against the interests of some and for the interests of others. The processes of planning, development and management require the consideration of alternatives and frequently a selected choice among interests. I make this point simply because this fact is the source of the greatest strain upon organization relationships as they are today, and no matter what the organizational pattern, these decisions must be made. Such conflicts are inherent. I don't know how they could be avoided.

Some of the agencies deal with but one facet of the resource -- many with several. With the advent of the concept of multiple-use or multiple-purpose and basin-wide comprehensive planning and development, the need for greater affinity between the agencies concerned became apparent. If an agency was to do its job, coordination and cooperation was a necessity. This was recognized in a long series of Congressional and Executive directives. Each agency with a primary responsibility for any part of the resource found that such cooperation and coordination enhanced its performance, and so coordinated. Like confidence, this coordination begot coordination and cooperation, and the effort snowballed.

Let's look at the interests involved. Paramount and dominant, of course, is the public interest -- something very hard to define and more difficult to measure. The resource belongs to the people, so, after all, what the people want to do with that asset is of great importance. This fact the planner and the manager must never overlook. His relationship to the people is the most important of all. This presents the second problem: Who are the people, and how do you determine their wants? Public hearings are one way. There seems never to be unanimity, or if there is, it is usually fleeting and borne of some major catastrophe. Everyone seems to be for flood control immediately following a devastating flood. Each group with an interest -- flood prevention, irrigation, power generation, recreation, fish, wildlife, or the like -- pushes hard for that interest, and it seems inevitable that a state or federal program invariably follows. The new emphasis on recreation and the Bureau of Outdoor Recreation is an example of that! Immediately there is established an affinity between the pushers and the agency charged with carrying out the program. The influence of these groups which are formed to promote an application of the resource is great, frequently determining. But the competition thus generated between groups may augur for the over-all good particularly since most have extended their influence beyond the single purpose for which they were established. I doubt if there is an administrator here who has not worked at some time with such associations as the National Reclamation Association, the National Rivers and Harbors Congress, the American Public Power Association, to name just a few. Perhaps organizations such as these are the "people" for practical purposes. We must maintain proper relationship with such groups.

State effort in the water resource field perhaps even more than the federal seems diffused in a labyrinth of state agencies each responsible to the public and to its clientele for the work it does. This problem has caused less concern than the federal multi-agency approach, perhaps because the state programs are generally dominated by the much larger, costlier, better financed, inter-state, federal programs. The states are not happy with this federal domination and are working together to improve the relationship of the state to the federal programs. The continuing struggle to establish a Columbia River Compact Commission is evidence of this effort. Perhaps regional planning should be done at the local level by the people themselves; then local plans to meet local needs would be prepared and fitted into the regional plans.

Let's enumerate a few of the more dominant uses to which our water resources are applied and review what agencies are directly concerned with each. The Corps of Engineers in its planning considers the following water-related functions:

1. Flood control.

2. Irrigation.

3. Drainage.

4. Water supply including quality.

5. Pollution abatement.

6. Navigation.

7. Recreation.

8. Fish and wildlife.

9. Power generation.

The Bureau of Reclamation lists the foregoing nine and adds a tenth -- Watershed treatment.

All or a portion of these functions must be considered by every other agency working in the resource field, and as the Hoover Commission and our own Inter-Agency Committee pointed out, there are some 20 federal agencies and another 30 to 50 state agencies involved. It does not follow that each of these agencies named has or shares responsibility for each of the functions listed, but it does mean that any agency in its plans for use of the resource for any purpose must consider its relationship to other purposes to which the resource might be applied and to the plans made by those other agencies.

A word on the mechanics now in use. I will use the Corps as an example since I know its work better than that of the other agencies, although all follow a similar pattern.

At the outset we are bound by and comply with a number of interagency agreements. First, of course, are the coordinating procedures prescribed by the Federal Inter-Agency Committee on Water Resources (Firebrick). Then we have special agreements with the Fish and Wildlife Service under Public Law 732, 79th Congress, known as the Coordinating Act. We have agreements with Interior and the Federal Power Commission respecting cost allocations and with the Soil Conservation Service respecting watershed small dam activities.

Briefly, our coordination runs like this:

We receive a directive to make a study for a specified purpose or indicated purposes.

When we have funds to proceed we notify all agencies concerned and ask for an expression of their interest in the study. With those that respond we immediately establish a liaison which is maintained until the study is completed. Again I remind you that there are many of them. 1/ Of course, not all have an interest or responsibility in the case of minor investigations but all do to one extent or another on major basin studies.

In preparing a plan, we determine first our resources, then our requirements, and formulate a plan. Sounds simple. But in determining our resources the basic information must be gathered, computed or compiled by many agencies. Likewise, requirements for the many uses of the resource may be the aggregate of the needs established by many agencies and again must be researched, computed and compiled. In all this process there are endless differences of opinion, discrepancies in data and conflict of use which must be reviewed, analyzed, harmonized or compromised. Through public hearings we contact local interests and local organizations.

Upon the initiation of a study we may establish, as indicated, an essential liaison with thirty or more agencies with varying interests and degrees of responsibility. From each of these we seek information relating to the resources and the requirements to be met which fall within the purview of its primary responsibilities. In providing us this information it in turn may, and usually does, need data from several other agencies, so the line of liaison may extend from the Corps to Agency A, and thence to B, C, D.

To illustrate, the Corps may ask the Public Health Service for water quality and low flow needs in a certain basin. To provide this information the Health Service must in turn contact a host of other agencies whose programs are also vitally affected by water quality as well as quantity -- fishery interests are an example. In turn some of these interests must consult further interests and so on, ad infinitum. In the meantime the Corps will have contacted these same agencies for information related to other aspects of the program, and the cycle begins again.

1/ Included are Bureau of Public Roads, Coast and Geodetic Survey, Census Bureau, Weather Bureau, Business Economics and Area Development, Federal Aviation Agency, Bureau of Reclamation, Bureau of Sport and Commercial Fisheries, National Park Service, Bureau of Mines, Bureau of Indian Affairs, Bureau of Land Management, Power Marketing Agencies, U. S. Geological Survey, State and Territorial Governors, and State Resource Agencies, Department of Health, Education and Welfare, Department of Labor, FPC, Coast Guard, International Joint Commission and Atomic Energy Commission.

Hence the fishery interests may find themselves furnishing one type of data directly to the Corps and other types to Public Health for the Corps. We have here a great web of cooperative effort, with its lines of liaison stretching from the center to the cooperating agencies which are joined by further concentrical lines of essential liaison.

It would appear to the uninformed that we have a hopelessly complicated and confused situation. Actually and in practice, this is not so. While many of the agencies do have duplicating and overlapping authority, few have duplicating or overlapping programs, and on their own initiative they gather together to coordinate their programs and their budgets and do quite a good job of working for each other, thus eliminating wasted effort. It is surprising what can be accomplished in this direction by an around-the-table conference of representatives of interested agencies. Of course, the advent of each new agency or bureau, or the delegation of new responsibilities to an existing agency, either at the state or federal level, increases the problem of coordination perhaps in geometric proportions. It is a fact of life that we add, but seldom subtract, an agency.

Planning, development, management of our water resources is now done almost wholly on a regional or basin-wide basis following the multiple-use or multiple-purpose concepts. Almost all of the federal agencies, and one or more of the states with the state agencies, are involved in varying degrees. The very nature of the problem has forced the abandonment of the unilateral or single-agency, single-state approach.

The earlier struggles to bring the responsible groups together led to the establishment of Inter-Agency Committees at the Washington level. These committees included in their membership the principal federal water resource agencies and sought to establish procedures to coordinate the work of those agencies. Their accomplishments, at that level, have been significant, but by no means have they solved all the problems confronting the planning and development agencies. In furtherance of their goals they established a number of field Inter-Agency Committees -- one in this region, the Columbia Basin Inter-Agency Committee. You are familiar with its membership, its mission, its performance. I have been associated rather intimately with the Committee since 1946 and have perhaps been its chief critic as well as its best friend. We have not over the years been outstandingly successful in improving its over-all performance, although its accomplishments, considering its make-up and operating limitations, have been most worthwhile.

Federal and state agencies maintain a cooperative relationship not only with respect to planning and development, but also in operation and management of their resources. We make great effort to accommodate one another and to manage or operate related facilities to obtain optimum benefits. The Columbia River Power System is an excellent example of this. Another example is the operation of the many reservoirs in the interest of flood control.

Coordination and cooperation begins at the agency level. Harmonious relationships at that level have solved most of the problems which arise from day to day. Each, to some degree, must depend upon the other and none can go very far alone. Thus, over the years we have developed a team relationship where each member has his part to play but respects the part of every other and works for the overall good of the team, or common objectives. Of course, some occasionally make a grandstand play, but his teammates pull him back in line. Then we have also the somewhat inconsistent statutory requirements governing different team members which also complicates the play.

While I have referred largely to the agencies operating at the state and federal level, there is a most important segment of effort that accumulatively plays a significant role. I refer to those local, largely single-purpose quasi-governmental legal entities organized pursuant to state law for the purpose of dealing usually with a local problem or single resource. These include the drainage, flood control, water, utility or soil conservation districts so active in the Pacific Northwest. They have a Board of Directors, usually a general manager, sometimes a staff, the authority to tax, administer, construct, operate and maintain the facilities essential in achieving their objectives. They operate independently, generally with a modicum of state or federal supervision, usually, however, within a broad framework of federal or state laws, and federal or state programs. In modern times they have grown quite dependent upon state or federal leadership and, in many cases, funds. They constitute a significant portion of the clientele of the federal development agencies and enjoy intimate relationship with the agency whose functions include those from which they benefit. These groups can become quite competitive with traditional agencies, and at times with each other.

I have not overlooked private enterprise in this discussion of organizational relationships. They, too, play a major and perhaps the primary role in the development and management of the water and related land resources. Examples of this are the large wood products industries which operate on a sustained yield basis and exercise the same thought and care in the preservation and management of their resources as the most advanced governmental body. Many of our corporations engaged in the development and operation of hydroelectric power facilities have broadened their concepts to include multi-use and exploit the recreation opportunities provided by their reservoirs and go to great effort and expense to preserve and even enhance the fish and wildlife aspects of their works. Motivation has come from several sources, not the least of which has been an informed public opinion.

I mentioned the Columbia River Compact, signed by the Commissioners only recently, which will be presented to the State Legislatures early next year for ratification. As I construe the terms of the compact, it will not be an operating or action agency, but will limit itself largely to review and recommendation with respect to the programs of the operating agencies, both state and federal. It will have authority to plan and may do so if it is the will of the Commission and the budgets permit the necessary staff. Just what the relationship of the Compact Commission, if it comes into being, will be to the resource planning and management agencies is not clear to me at the moment. It would appear to provide a vehicle of the states' own creation wherein they may gather to speak with a common voice at the conference table. It should tend to encourage interstate coordination and cooperation, and may provide a means for facilitating federal-state effort. But it does add one more agency to the many now operating in the field of water resource work, and I remind you that there are those who believe we need fewer, not more.

So this is the spectrum of the water-oriented agencies. At one end are the people -- whether on the short or long end is sometimes argued. Then we have the "local interests", the organized and unorganized groups sponsoring some specific water use or application. Follows then the state and its agencies, and finally the federal government, and its agencies.

I have not elaborated on any of the relationships mentioned. This is a symposium. I know that most of you have a much more profound knowledge of this subject than I, and I hope that in the discussion which follows, you will elaborate, emphasize and fill in where necessary.

DISCUSSION

Q. It seems to me that you have described the status quo in the way in which the regional organizations are working. You also said that there were a great many fine studies on library shelves gathering dust. This is a research symposium the purpose of which is to point out areas where research is needed. Everyone has been saying that we need more research on organizations to do the job better. I wonder if you wish to make some comments on what you think the research needs in this area of organization might be.

A. We do not need any more studies to determine the organizational pattern that should be followed. I think the studies have been studied. Now perhaps we should research on how to implement the studies. The best brains that were obtainable and vast amounts of money and time have been expended. Every conceivable possible theory of organization has been put to the people. You know what advance we have made, if you want to call it "advance." This has been written up time and time again until you don't know where to begin or where to end. Frankly, I do not believe we need any more research to find the best organization to do the job, but need to take the tools we have and move ahead. It is no longer academic - we have the facts we need.

Q. One of our speakers mentioned that we should never underestimate the ignorance of the public. You make a statement in reference to the well-informed public as far as decisions are concerned with water resource development.

A. Who is the public? Generally, for the administrator, the people who are here are the public. You were interested enough to come in and listen and you are the only public I know.

Q. The Columbia Basin Inter-Agency Committee is strictly a cooperative planning group and, therefore, it has no power to create any master plan like, for instance, the Texas Commission that recently created a very comprehensive plan for the entire state of Texas. Isn't there some way we can add a little more force to the planning in the Inter-Agency Committee?

A. What you are saying is that the Inter-Agency Committee has no statutory basis. It exists by virtue of an executive order of the President, so has a legal basis. It is not an administrative body. It has no money and no staff. Therefore, it has no authority to prepare a plan. You can't prepare a plan in a vacuum. If the Committee had the wherewithal to do it, there would be nothing illegal about it. The Texas Commission had a staff that spent its time taking the plans of the constituent agencies - state and federal - and putting together a master plan. There is no reason why the CBIAC couldn't do that if it had the wherewithal.

COMMENT: This might be a good place for those who are not familiar with it to mention the Murray-Metcalf administration bill for water resources planning. This bill would provide a statutory river basin commission with the authority to plan and review. It would go above the voluntary CBIAC and the temporary Study Commissions such as those of Texas and the Southeast, into a more permanent planning and development control organization with top leadership at the executive level and with statutory recognition.

COMMENT: Throughout this meeting we have not discussed the need for institutional changes. We have considered water quality management policies and decisions in light of existing agencies. As was so emphatically pointed out, no new research in organizational change is needed. I think this is a great understatement and misconception. Institutional organization should be considered as a variable in water quality management or newer concepts in economic and technological research will be of limited use.

COMPREHENSIVE PLANNING FOR WATER QUALITY CONTROL

Reginald C. Price*

It is a pleasure to join in this Symposium on the social and economic aspects of water-resource quality control. It is a broad and timely subject. In California we have endeavored to face up to the immediate and future needs for recognition of water quality as an essential element of development of the water resources of our State.

During many years of participation in water resources activity, I have observed here and abroad what happens when water quality is permitted to deteriorate to the point where impairment of water use results. Yet we can take hope in man's ingenuity and capacity to live together in cities without turning them into dunghills. For in Pakistan near Hyderabad, I have seen the ancient city of Mohenjo-daro, 5,000 years old, which boasted a water-borne sewer system to remove its wastes. We should be able by this time to do better than we do.

Yet President John F. Kennedy has called our situation "a national disgrace." In his message on natural resources, he told Congress, "Pollution of our country's rivers and streams has reached alarming proportions."

In my remarks today I shall bring out the contribution that comprehensive planning for water quality control can and must make to the realization of water qualities that are adequate to their uses. Here in the Pacific Northwest water appears in greater abundance than in California where we need to stretch scanty water resources to the maximum. But in both areas the solution of the water problem calls for men of vision who recognize that it is not enough to have water that is wet, not enough to have water sufficient in quantity, but that the demands of water quality as well must be met.

Such planning for water quality takes place within the scope of water quality management. For convenience, I define Water Quality Management, to depart slightly from the Kerr Committee terminology, as "the program within a particular geographic area by which a recognized body actively facilitates the provision of the right quality of water in the right quantities for the purposes to be served at the points where needed at the time when required." While I have used the word "area," you may substitute "basin," "state," or "region," or even "nation" for that matter.

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*Deputy Director, California Department of Water Resources, Sacramento, California

The realization of such a program depends first on the determination of the kinds of water uses anticipated, the places of such uses, and the times.

Contemplating such determinations immediately plunges us into comprehensive planning. I have mused a bit over that term "comprehensive planning," but our projection here is comprehensive any way you slice it, geographically, functionally, or organizationally. Involved in such a planning activity are the agencies concerned with water pollution control, water development, public health, fish and game, domestic water supply, population growth studies, industrial development, recreation, waste disposal, power production, irrigation, and others. All must pool their skills and talents to arrive at the important answer to the key question in water quality management -- and I repeat for emphasis: What kind of water uses will develop, where and when? To add to the problem, the agencies involved may be federal, state, local, and private -- each must be involved, however, because each has a contribution to make to a successfully operating plan and program.

Once the place, time, and nature of water needs have been determined, the next step is to determine the source of water supply to meet the needs and the route by which the water is to arrive at its destination. These factors establish the basis upon which to build a water quality management program. The nature of the use tells us what water quality must be provided at the point of delivery. The identification and location of the source of water indicates the original quality of the water to be delivered, and that must be related to the route of conveyance to determine the existing and potential uses and the existing and potential sources of water quality degradation along the route.

I realize that I cannot hoodwink you. While I have telescoped this process for the purposes of this discussion, in fact it may be a long, tedious, complicated and exacting undertaking. Comprehensive planning of water quality is not a simple thing, particularly when it must be delicately adjusted within the context of several uses.

In California we are fortunate in having already developed a basis for marshalling the interdepartmental forces and the skills requisite to the forecasting of water use. Following more than 10 years of study of the State's water resources, problems and needs, a general plan for comprehensive water development throughout the State was prepared. This investigation was conceived as a fundamental, comprehensive survey, designed to serve as a basis for a logical and orderly pattern of development.

The first phase consisted of an inventory of the basic water resources of the State; the second phase dealt with present and ultimate requirements for water.

These two investigations formed the basis for the development of the California Water Plan, the final phase, which is a master plan to guide and coordinate the planning and construction by all agencies of works required for the control, conservation, and distribution of California's water resources for the benefit of all areas in the State and for all beneficial uses. It is envisioned that all interests, including local, state, federal, and private, will participate and share in this task. The plan contemplates that each will build those units that fit into its program and warrant its participation.

In the summary on the water quality section, the California Water Plan states that "... unless the quality of the State's water resources is maintained at proper levels, full satisfaction of California's ultimate water requirements will not be possible."

Fortunately, as early as in 1951, through the coordinated efforts of the State Departments of Water Resources, Fish and Game, Public Health, and the State and Regional Water Pollution Control Boards, the State of California had initiated a statewide surface water quality monitoring program, subsequently supplemented by a ground water monitoring program, to record water quality information on a continuing long-range basis in anticipation of the time when full development of all our water resources will be required. Such data will blend into the developing State Water Plan, for such a plan is never final.

One segment of the California Water Plan is the State Water Project. This is being constructed by the State itself through its Department of Water Resources. We are in the midst of an exciting 11-year construction schedule. We expect to begin to deliver water in southern California from northern California, 750 miles north to south, by 1972.

The significance of water quality in the State Water Project is brought into sharp focus in the contract executed between the

State, acting through the Department of Water Resources, and the Metropolitan Water District of Southern California, for the sale of water from the State Water Project. It declares that it is the objective of the State to provide water of high quality. It outlines water quality in unmistakable terms of actual water composition.

This feature of the contract represents an historic expression of state policy. It is a formal declaration that water quality is an essential factor in water supply. It defines tolerable degradation in source waters, and thus limits the extent to which these waters can be used for waste disposal. It obligates the State to exercise reasonable precautions and establish adequate controls toward achievement of these high water quality objectives.

These goals are based on planned water quality in the Sacramento-San Joaquin Delta, which is the focal point for pooling and transfer of surplus northern California waters to water-deficient areas of the State. In formulating these objectives, the basically conflicting considerations of clean water and waste disposal are resolved in a manner to attain high water quality and yet not impede economic development of the tributary watersheds.

Under State Water Project, temperature is another aspect of water quality. In order to provide more effective control of the temperature of water released from Oroville Reservoir in the interest of fish and rice production, a multilevel control work has replaced the earlier-planned single-level outlet. I recall that the Governor of Iwote Prefecture in Japan, kneeling across the table from me, remarked pertinently that for every degree warmer the water could be taken from their reservoir in the Kitakami Basin, they could increase the irrigated rice yield by five percent. Fish, agriculture, water quality -- frequent bedfellows.

Having talked in broad terms to this point, we now begin to put some flesh on the bones of comprehensive planning.

Planning the Program - Quality Criteria for Water Use

From a water quality standpoint, the need to know the nature of each anticipated water use is dictated by the need to determine the water quality criteria necessary economically to support that use. In this sense, a water quality criterion is a standard for judging the adequacy of water quality for a particular use.

The establishment of water quality criteria is, as many of you know, sometimes a frustrating field of activity because of the uncertainty of the effect of water quality on certain water uses. It is particularly in the field of public health that water quality criteria have received some degree of acceptability. This acceptability is due in large measure to the professional competency, the prestige, and reputation of the United States Public Health Service which formulated the original and has continued the custodianship of the drinking water standards. As you know, the U. S. Public Health Service, in developing the drinking water standards, had in mind a guide to the quality of water used by travelers on interstate carriers. The standards, therefore, apply to the quality of water delivered to consumers, or the finished water. This point is sometimes lost sight of in using the drinking water standards generally as water quality objectives in water resources development.

I recall the tale from the Peshawar bazaar in Pakistan concerning the young Greek Alexander who came jangling out of the west, seeking the foundation of eternity. He found the spring of eternal youth and was about to drink when a pitiful being crawled before him, croaking: "Do not drink this water, king, or you will become like me - 5,000 years old and able neither to live nor to die." It is possible to set a standard too high, as did Alexander, and Ponce de Leon in our own country. As Abel Wolman observed many years ago, it is necessary to balance the B.O.D. against the C.O.D., the benefits of B.O.D. reduction against the economic costs.

The acceptance of general industrial water quality criteria is hampered by the tremendous variability in industrial water use, and the wide range in the quality necessary to these various uses. For example, reclaimed sewage may be satisfactory for some industrial cooling purposes; when, however, product contamination is a factor, nothing less than a biologically safe water, at least equal to drinking water in quality, is necessary.

General water quality criteria for agriculture have been even more uncertain because of the need to consider at least the irrigated crop, soil condition, irrigation practice and drainage. Another factor of importance in irrigation water quality is that the concentration of salts is directly related to the leaching requirement necessary to remove from the root zone the salts deposited as a result of transpiration and evaporation. An increase in the salt concentration of an irrigation supply results in an increased requirement for leaching water to maintain productivity. Thus concentration of salts in irrigation water is almost directly reflected in economic cost.

When water uses include recreation, such as swimming, skin diving, boating, we are faced with an area of water quality affected, to considerable extent, by the intangibles associated with the aesthetics of water use.

The consideration of water quality criteria must be applied not only to the end-of-the-line water uses but also to those uses which may exist or be anticipated along the water route. If the conveyance route is a natural channel, these uses might be, for example, domestic water supply, recreation, fish propagation, or navigation.

Water Quality Degradation

As the next step in our development of a water quality management program, it is necessary to locate, identify, and evaluate sources of degradation, existing and potential. If a waste discharge of agricultural drainage is involved, we need to know about waste disposal practice, volume of waste, quality of wastes, discharge schedules, benefit to community, costs and economics of waste disposal location, nature of waste, and necessary degree of treatment. If the source of degradation has natural origins as indicated by sea-water intrusion, seepage and drainage, the mechanism and effects of the degradation must be studied and understood.

Objectives for Water Quality Management

With the cataloging of the criteria necessary to support particular existing and potential water uses and the sources of existing and potential sources of degradation, we move to the important step of defining the water quality objectives. A water quality objective I define as a statement of intent to maintain a specific level of water quality at certain key points in a stream system. The objectives are established with due regard to such factors as the following: economics of water use and waste treatment, water quality criteria selected for downstream water use, technological capability for treating wastes, land and water use planning along stream in question and streamflow regimen. These objectives are developed by integrating the various criteria necessary to support those various existing and potential uses which do or may occur along the conveyance route below key points in the stream system. The process of establishing objectives must at this point in the development of a water quality management program be a cut-and-try system of balancing the many factors which go to make up the objectives. A discussion of these factors to be considered in preparing the objectives could well form a basis for a text and the time allotted here permits only brief treatment.

I will advance, however, as tentative suggestions, a few basic ideas which are still in process of development in my own State. These ideas are not officially sanctioned and will no doubt be well scrambled before possible final acceptance as a basis for a concrete program, but you may find them of interest:

1. Water quality objectives should not unduly restrict development in the upper stream system to provide for downstream water use, but rather should provide for reasonable future development and use and factors of safety.

2. Objectives should be those necessary to support a fully developed program. However, it may be permissible to allow temporary deviation from the objectives in the event that certain uses will not develop until a later time.

3. Waste dischargers do not acquire a right to pollute.

4. The objectives should recognize that waste discharge to a stream is a beneficial use only so long as the other uses of the stream are not unreasonably affected.

5. The objectives should recognize that, in the public interest, waste discharges should not cause pollution, health hazard, unsightliness, or odor nuisance.

6. The objectives must be coordinated with all agencies having an interest in water use, including pollution control, fish and game, recreation, health agencies, and others having responsibilities in the surveillance of water quality or planning for the use of affected resources.

7. Public hearings should be held to subject the objectives to public opinion prior to final adoption.

Water Quality Management

After the basic factors of use and water quality criteria have been evaluated and the objectives established, we can develop the action phase of the water quality management program. The action requires bringing the existing and anticipated future quality in the stream system into consistency with the water quality objectives. If the objectives have been properly coordinated so as to reflect the interests of other agencies, the action step becomes simpler. When the existing or anticipated stream quality will not meet the objectives because of waste discharges, the pollution control agencies have a responsibility. The pollution agencies should translate the over-all objective into waste discharge requirements for each discharge together with a schedule for accomplishing compliance. A waste monitoring program is needed to assure that waste discharges meet requirements.

Where the water quality will not meet objectives and the failure to do so cannot be attributed to waste discharges, an effort to maintain higher minimum diluting flows may be necessary. The solution may lie in including in an existing or proposed project a storage reservation for sufficient water to provide quality control. You will recall that Public Law 87-88th Congress made storage for quality control a paying partner of federal water projects. A reservation may be necessary to control the effects of those residual wastes discharged from treatment plants, for which dilution or disposal outside the stream system constitute the only feasible solution.

Or a master sewer or drain might be constructed to collect wastes and drainage normally discharging to a stream for transport to a site where discharge would not cause a quality problem.

Organizational and Financial Requirement for Solving Water Quality Problems

Realization of a sound program of water quality management will depend to a great degree on implementation through proper organizational structure and methods of financing. Some random ideas may throw some light, as follows:

1. The agency best charged with the responsibility for water quality management is one which can effectively coordinate the efforts of the resources, health and pollution control agencies.

2. Governmental districts, if pertinent, should be organized to provide broad base solutions to water quality problems. These districts are desirable because fewer over-all waste disposal and collection systems are preferable to more numerous smaller discharges; the larger system provides a more substantial tax base for financing greater economy and greater financial flexibility.

3. Where the benefits of release of water or other remedial measure for quality control can definitely be assigned to one or more dischargers, these dischargers should share the costs.

4. The funds to finance waste disposal should be obtained in either or both of two ways:

(a) By a direct charge on waste discharger to reflect direct benefit supplemented by

(b) Tax revenue on an ad valorem basis in order to reflect secondary and other benefits.

5. Benefits for water quality control should be evaluated in dollar terms to the extent practicable. A suggestive list of such benefits is attached at the back of these remarks. It is intended to serve only as a rough guide to the identification of the benefits, with full recognition that the more difficult step is their conversion to a monetary basis.

Research

A well operating water quality management program must have as an integral part a properly conducted research program geared to provide the solutions to water quality management problems. It is essential that these problems be anticipated ahead of time to ensure that solutions are ready when they are needed.

Considerable research, much of which is not going on, is needed, of course, in the field of waste treatment to remove problem waste constituents such as insecticides and pesticides, etc. In addition, research is needed in the field of instrumentation for continuous water quality monitoring, in the use of bioassay techniques for waste evaluation, in the quality aspects of water-associated recreation and in the determination of long-range effects of the newer organic molecules discharged to our streams as a requisite for more adequate quality criteria.

As a further contribution in this field of water quality, the California State Water Pollution Control Board, in collaboration with the U. S. Public Health Service, is sponsoring the publication of the second edition of "Water Quality Criteria." This newest volume,which brings up to date the first edition, will be ready for distribution shortly.

In addition to research into the purely technical aspects of water quality, however, there is a critical need for study of the economic aspects - particularly into methods for converting economic benefits, after they have been identified, into dollar values. This information is necessary in order that a definite dollar figure can be attached to the benefit of having a water whose hardness or solids concentration, for example, is less than that of an alternate source. With such data, projects having water quality management features can be more adequately evaluated.

Conclusions

Our scenic tour of the considerations involved in the comprehensive planning of water quality control has encompassed a number of vista points. We have identified the relationship between the projected water uses, the sources of supply and the means of conveyance from source to use. After setting out the criteria for particular uses and reflecting on sources of degradation, we have pursued a grand integration of the various criteria in formulating broad objectives for water quality. Then by comparing standards of available water with objectives, one can determine any necessary measures to upgrade the water to facilitate the meeting of objectives.

In order to press forward toward the drawing of adequate plans for water quality, whether state or regional or basin, two points stand out:

1. Water quality management is an integral element of broader-scale water resources management.

2. In the comprehensive planning for water quality, the administering agency needs to realize full coordination with those involved in furthering the various uses of water for fish, for agriculture, for municipal purposes and for all pertinent uses to be served.

California pushes forward vigorously toward the incorporation of a water quality in its State Water Plan. I am confident that the entire Pacific Coast area will find the rewards of water quality adequate to justify the effort of securing it.

WATER QUALITY CONTROL BENEFITS

Municipal Use

1. Reduction in cost of softening when hardness is a factor.
2. Reduction in appliance damage.
3. Reduction of damage to clothing in laundering.
4. Reduction in costs of treating water.
5. Reduction in loss due to corrosiveness or aggressiveness of water.
6. Reduction in soap and detergent use.
7. More intensive use of land at outfall vicinity and increment in land value.

Industrial Use

1. Reduction in treatment costs.
2. Reduction in loss due to corrosiveness of water.

Agricultural Use

1. Reduction in costs of leaching water.
2. Increase in crop yield due to absence of toxic constituents.

Public Health

1. Reduction of incidence of water-borne disease.
2. Minimizing taste and odor effects.

Recreation Use

1. Increase in recreation with more attractive recreational area.

Fish and Wildlife

1. Increase in value of fisheries and recreation due to fish enhancement.

DISCUSSION OF PAPER PRESENTED BY REGINALD PRICE

W. W. Towne*

Mr. Price's paper emphasizes the importance of including water quality management as an integral part in any total water resources development program. The California experience also demonstrates how a state through its various departments and agencies having water-oriented interests can exert a leading role in developing a master plan for the maximum utilization of the state's water resources. As is further emphasized, however, regardless of who takes the lead, the desirable endpoint can only be reached through a cooperative effort between state, local, and federal agencies.

The California Water Plan is a history-making undertaking and I am sure that all of us in the planning fields will profit immensely by the pioneering work done by the State of California.

This and other papers and discussions here at this Symposium have been of particular interest and value to this discussor because as some of you know the Public Health Service is engaged in a study designed to develop a comprehensive plan for the water supply, pollution control, and water quality management aspects of water resources development in the Columbia River Basin. Also, because of the close economic and resources interrelationship of the Oregon and Washington coastal areas with those of the Columbia Basin, these areas are also included in the study.

An introductory report describing our objectives, scope, and purpose of the study project was published some eighteen months ago and is available upon request. This study is being conducted in compliance with the directives of Congress as stated in the Federal Water Pollution Control Act, Section II, which directs the Secretary of Health, Education, and Welfare to prepare or develop comprehensive programs for eliminating or reducing the pollution of inter-state waters and tributaries thereof in cooperation with other federal agencies, the state water pollution control agencies, and inter-state agencies, and with the municipalities and industries involved. The Act further states that in the development of such comprehensive programs, due regard shall be given to the improvements which are necessary to conserve such waters for public water supplies; propagation of fish and aquatic life and wildlife; recreational purposes; and agricultural, industrial, and other legitimate uses.

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*Director, Columbia River Basin Project, Water Supply and Pollution Control Program, Pacific Northwest, Public Health Service, Portland, Oregon.

From the above, it is apparent that Congress also recognizes the importance of a cooperative effort in developing plans for the development of our natural resources.

One of the principal objectives of our study is to develop essential data and information on water supply and water quality aspects to serve as a guide to the public in arriving at the political and legislative decisions necessary to control the orderly development of land and water resources of the region. We are fully cognizant that state and local governmental agencies have the primary responsibilities to prevent and control water pollution within their borders and through their legislative authority are in a position to greatly influence many factors which will affect water quality.

We in the Public Health Service have been guided significantly by the water quality objectives established by the Northwest Pollution Control Council, an organization of state regulatory pollution control agencies in the Pacific Northwest. Quoting from the publication "Water Quality Objectives of the Pollution Control Council": "The Pacific Northwest is at present in an enviable position as regards its natural resources and potential development when compared with many other areas of this country. This is especially true of the natural waters which are admittedly one of the area's greatest assets. Water is so definitely tied in with the health, welfare, and pleasure of citizens and with the whole economic structure of the area as to make high water objectives not only desirable, but imperative."

This, then, serves as a guiding principal to our study and reflects the public opinion of the area. We believe that the area is also in a stage of its development that it can profit by the experience of others.

In the past, resource planning and control has all too often followed serious depletion or despoiling of that resource. Here, water quality is still generally very good with vast quantities of relatively unpolluted water available.

In general, the Columbia River Basin is at the point where preventive measures can insure continued good water quality and maximum utilization and development of the land and water resources.

We think, for instance, that it would be penny-wise and pound-foolish to establish water quality objectives which would barely satisfy the needs of the various water uses.

In this area -- high water quality -- such standards would not be standards of quality but would become standards of degradation inviting all water users to return their used water with the very minimum of treatment.

As Mr. Price has pointed out and as was stated at the National Conference on Water Pollution, 1960, users of water do not have an inherent right to pollute and have the responsibility for returning the used water as nearly clean as is technically possible. We realize that as our water resources become more completely utilized, conflicts in water use will develop. The adjudication of these conflicts can only be made by considering all water uses and their effect upon quality.

Unfortunately, every water use exerts some water quality degradation and it is in these areas of adjudication that social and economic factors will need to be clearly defined.

Broadly speaking, in our study we are attempting to provide a technical evaluation of the following factors:

1. Quantity and quality of water required to develop the land and water resources of the basin.

2. Effects of economic and industrial development upon the several water uses in the basin, both quality and quantity wise.

3. Availability of both underground and surface waters in the basin and the possibility of adding to the total water resource.

4. Conflicts among water uses and means of adjudication.

5. Alternative conditions resulting from the establishment of priorities in water use in the event that conflicts develop which cannot be resolved to permit full use for all purposes.

6. Research needs.

A plan based upon the above factors is essential, we believe, to guide the public in arriving at the political and the legislative decisions that will be necessary to control the orderly development of the land and water resources in the best interests of the public. These evaluations will also serve as guides to state, local, and federal governmental agencies in carrying out their responsibilities; and, furthermore, they will serve as a basis for developing the most logical plan for implementing a really comprehensive water quality management program.

We are now in our second year of study, and it is anticipated that with proper budgetary support, the study will terminate in approximately three more years.

Plans, of course, are of little value unless they are put into operation. Therefore, plans for managing water quality of the basin should set forth ways and means of accomplishing the objectives, including the social and economic effects which may take place as a result of alternative approaches. It is in this area of social and economic research associated with program implementation that I think this group can render its greatest service.

In closing, I would like to discuss briefly one additional facet of our studies. As Mr. Price indicated, the Federal Water Pollution Control Act was amended in 1961 requiring that consideration be given to the inclusion of storage for the regulation of stream flow for the purpose of water quality control in federally constructed reservoirs, except that any such storage and water releases shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source.

Unfortunately, some people have interpreted the Act to infer that reservoir storage could become a substitute for sewage treatment. Such is not the case.

It is a well-known fact that the art of sewage and waste treatment has not progressed to the point that we can remove 100 per cent of the polluting substances. Furthermore, certain uses of water deteriorate water quality in a way which is not amenable to waste treatment. Therefore, in order to reduce the concentration of the residual waste from treatment plant effluents as well as those wastes from numerous other water uses which are not amenable to treatment, increases in minimum stream flows will be required if water quality essential for downstream uses is to be maintained.

Furthermore, with the rapid expansion of industrial activity and increasing variety of industrial processes, we are constantly confronted with new waste treatment problems, the solution of which requires time, effort, and money.

Dilution of such wastes below objectionable limits during critical stream flow periods can serve two purposes. First, the immediate purpose of maintaining necessary water quality for downstream uses. And secondly, and probably more important, the availability of this stored water (both quantity and quality wise) for expanding other uses.

As was stated here yesterday, consideration must not only be given to supplying water for essential water uses but equal consideration must be given to the treatment and disposal of used water. In many locations in this country, the limitation of a multiple-purpose reservoir development has frequently rested more upon the capabilities of handling the used water than how much water could be developed for the initial use.

It becomes apparent, therefore, that planning for water quality control must constitute an integral part of any water and land resources development program and encompasses much more than the technical problems of waste treatment. As our water resources become more fully utilized here in the Pacific Northwest, these facts will become increasingly significant.

DISCUSSION

Q. The California **Water Plan** project has been clearly presented as a wholesale water supply measure. There are two other levels, obviously, the distribution at the retail level and the level of final utilization. What is the state doing about these two lower levels?

A. We are cognizant, of course, of the close relationship between these three levels of use. However, the state water project is concerned with the quality of water that will flow down the Sacramento, be picked up in the delta, and pumped at several points, and then flow through the California aqueduct to the south. We will be selling this water on a wholesale basis at several points to the Los Angeles Metropolitan Water District and to several other customers along the way. Our contracts have been set in terms of the objectives of water quality with respect to that which we may be able to deliver water to our wholesale customers. These standards are high. They are in effect comparable to the standards associated with water for direct consumption so that while our primary interest is in these standards as they may be associated with our customers, the effect is to represent a recognition of the standards which are applicable with respect to these other levels.

Q. What research is being done in connection with the California Water Plan especially as concerns the social and economic aspects?

A. In the first place, the Department of Water Resources is not primarily a research agency. The Legislature of California has indicated that it is not a research agency. We stimulate the University of California at Berkeley and other universities to carry out such research.

COMMENT: It is true that the Sacramento and San Joaquin Rivers are completely within the State of California. However, it seems that the concept of the state water plan embracing both water quality and water quantity is one that can be projected more widely and that states could be in a position to take up this concept, even recognizing that several states may be involved in connection with a particular river. There is a financial consideration and California is very fortunate in having oil wells just off the coast which has helped the state get started on its water project. The reference to the way in which the water quality standards would need in the end to be implemented is pertinent because the Public Health Service would be in a position to carry out research and studies and make certain recommendations, but in the end it must fall upon the state to implement them.

Q. In reference to the contract between the State Water Resources Department and the Metropolitan Water District in southern California, it was stated that the water quality in unmistakable terms was written into the contract. Do you remember some of these criteria more specifically and do you feel that the state has done correctly in signing a contract that has guaranteed quality for the metropolitan area, knowing the many variables that will come into play upstream?

A. At present in southern California, water which is delivered through the aqueduct from the Colorado River has around 660 ppm of salts. They are waiting for the day in 1972 when they will be able to bring water from the north with about 220 ppm. The specific standards for each individual element in the water supply are set out with some detail in the contract. However, these standards are set out not as a guarantee but as an objective. In other words, the state undertakes to operate this system with the objective of meeting these water quality standards in the delivery of water to customers. We expect fully to meet them.

Q. Will the water be transported in open channels or closed aqueducts and what is being done to cut transmission losses?

A. The aqueducts will be open for the most part - the major exception is in going through the Tehachapi Mountains. These are the mountains which divide southern and northern California. There will be tunnels through these mountains. The California aqueduct will more or less parallel the existing Bureau of Reclamation aqueduct. The South Bay aqueduct is about one-third finished and already delivering water to one customer. Since we have only just started the reservoir, we are presently purchasing water from the Bureau of Reclamation. These canals are lined for the most part to minimize losses.

Q. Is the San Joaquin drainage canal definitely in the project?

A. The Department of Water Resources is studying the construction of a drain to dispose of wastes arriving from irrigated areas and there is a possibility that there might be a master drain which would permit a joint construction between the Bureau of Reclamation and the state to serve the needs of both agencies. The exact solution is not yet in sight.

Q. Has the Department of Water Resources made any investigation of the economic aspects of delivering water to San Diego and the comparative cost of the reclamation of sea water?

A. Yes, we have been maintaining a continuing cognizance with respect to the sea-water studies. There is a reclamation plant at Point Loma and San Diego. The costs of the water there are substantially four times the cost of the water that is now being brought in from this other area so that there has been a very substantial differential. It is true that the differential has been narrowing, but there is no immediate indication that these will be competitive in the near future. As a matter of fact, when the Point Loma water was being disbursed they couldn't sell it to the city of San Diego. As a result, they had to enter into a contract by which San Diego paid no more for the water than if they were getting it from the Colorado River.

Q. I'm interested in the relationship of economic research to this project. You touched on one aspect of this relationship, which is the problem of putting a dollar and cents value on the benefits. There is another aspect where economic research would come in - that is, the economic base study which you must have made to determine how to allocate the water from the north to the south. I suppose you made an economic base study to determine the future competitive needs and allocations.

A. There have been in the course of the state's water planning studies very elaborate inquiries into each of the areas of the state with respect to the available water supplies and their needs. It was on the basis of these studies that the over-all State Water Plan was developed to identify the areas of deficiency (these are in the south) and to identify also the areas of surplus which are in the north. For many years this was a source of controversy because, while the State Department of Water Resources would point out that there were surpluses in the north, the people in that area said, "We don't agree with you. We need all the water we've got and we don't intend to give up any." What was done was in part by the Department of Water Resources and in part by the Legislature, both by statute and department policies. It is established that the first call on these waters from the north will be used to meet both existing and future requirements of that area. This has sometimes been lost sight of in that the people from the north have said, "You'll take care of us for the moment, but what about 20 years from now?" Finally, in 1960 the controversy was resolved when the matter was placed on the ballot and the people of California in effect voted to recognize that the state has guaranteed to meet the requirements of the northern part of the state and assured and approved the export of the surplus water to the south. In this ballot in 1960 stateside approval was given to the export of the water from this basin.

Q. In determining that there was actually a water surplus, I suppose you made an economics base study and projected it out to X year.

A. The projection presently goes to 1990. Originally we went beyond the year 2000. But it was found that the most feasible basis was to stop at the year 1990. The present project is formulated on that basis. As the waters in the delta will be depleted year by year, between now and 1990, there will be a need for additional storage beyond the four million acre-feet now provided. To meet these requirements, studies are presently underway in other rivers in this north coastal area looking toward replacement storage which will be constructed to take care of these depletions.

COMMENT: Before we proceed with the summary of this symposium I would like to make a comment regarding research needs. As I see resource management problems, there are two phases that need research: (1) the allocation problem - of what relevance is a price system when we have a mixture of public and private goods offered? (2) the administrative problem - what agency or organizational structure will create the best decisions with the most efficiency?

The economists are concerned with efficiency in the use of resources, giving the consumer that optimum combination of quality and quantity. Administrative problems come in the realm of the political scientist. Yet both problems have a common link which is to define the objectives on which their separate scientific contributions should focus. This is recognized, but not in an explicit manner. Economists are too concerned with economic values, preferring not to define (or recognize) social and public interest values. The economist proposes a set of tools for optimizing economic values, with little awareness of the effects of social and public interest values in his model. The latter are difficult to measure. More research should be devoted to such items as social costs of water pollution. No economist has yet come up with a useful theory for application to resource problems in an economic system such as ours with its mixture of public and private property.

Sociologists and political scientists find it difficult to measure social values, while public interest values tend to become determined by administrators and planners. The task is to synthesize a combination of tools and effort to work on the resolution of conflicts between these value systems, as is done in the multidisciplinary approach. This would mean weighing the merit of each approach, hoping that the mixture produces a richer product.

My suggestion for research is to focus on the value systems, to study objectives and set forth more explicit ideas of what planning is for, of what importance are quality objectives and how the divergent viewpoints can be incorporated into resource problems. A specific problem is what value can be attached to different levels of water quality.

SUMMARY AND CONCLUSIONS

Allan Hirsch*

Research on the political, economic, and sociological aspects of water quality control is necessary to guide the important public programs in this field, but very little such research is currently being done. The present symposium can be contrasted with previous symposiums in this series on topics such as "Siltation--Its Sources and Effects on the Aquatic Environment," "Oceanographic and Related Estuarial Pollution Problems of the Northwest," and "Toxicity in the Aquatic Environment," where the discussions involved on-going research projects. During the present meeting, the discussions have largely involved broad areas of research needs rather than current research projects and have indicated the dearth of research in this area.

For this reason, it is gratifying to learn of Allen Kneese's studies. The number of times which these were cited in the discussions is illustrative of the real value of an analytical approach to this subject. Dr. Castle's work in applying some of these principles in the Pacific Northwest region is also encouraging, as are the studies at the University of California and the University of Washington which were mentioned.

Research in this area must be intensified. The growing interest in outdoor recreation and hunting and fishing, the report of the Outdoor Recreation Resources Review Commission, and the establishment of the Bureau of Outdoor Recreation in the Department of the Interior, give some assurance that, at least in these related areas, many of the most difficult evaluation problems will receive more attention. Perhaps this will result in findings which can be translated for use in water quality control programs.

Workers in the field of water quality control must look to related work in other fields. It is probable that existing findings, or at least existing methodologies, which have been developed by social science research in various fields, can readily be utilized in studies on water quality control. This has been a major purpose of the symposium -- to bring the research needs of water quality control to the attention of persons working in other related fields.

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*Chief, Planning Branch, Columbia River Basin Project, Water Supply and Pollution Control Program, Pacific Northwest, Public Health Service, Portland, Oregon.

The ultimate application of research in the social and economic aspects of water quality control is to guide public programs by making them more responsive to what the public needs are, and more effective in meeting those needs. Norman Wengert, writing in the "Natural Resources Journal," has said:

> "The problem of providing standards for appraising public programs and determining the public interest presents a double challenge -- to administration to develop mechanisms, procedures and institutions for making more rational choices and for setting wise priorities, and to scholarship to prove and analyze public programs in order to determine their consequences and to assess the extent to which they fulfill needs and expectations." 1/

Leonard Dworsky, in presenting the first address of the symposium, made a statement in much the same vein. He said that persons responsible for administrating pollution control programs will do what is necessary to carry out their responsibilities, and that they will continue to carry out these responsibilities as effectively as possible, but that the assistance of scholars in universities and elsewhere who can study these activities on a more analytical basis can help them to do a better job.

Many of the research needs that were discussed during the seminar could be placed into one of two categories:

(a) Research on actual situations, where the researcher is observing and appraising reality. This is the case study approach -- why and how something has happened. Mr. Dworsky described in his address some potential topics for case studies, such as a critique of federal pollution control enforcement policies and a study of the federal sewage treatment works construction grants program, with its implications for federal-state-local governmental relationships. He pointed out that it would be most helpful to have scholarly appraisals of these operations.

The case study approach has the advantage that it does deal with an actual situation; at the same time, however, since a

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1/ Norman Wengert, Resource Development and the Public Interest: A Challenge for Research, Natural Resources Journal, Volume 1, No. 2, November 1961, pp. 207-223.

specific situation is being studied, generalizations made in such an approach may be limited or subject to many qualifications.

(b) An attempt to approximate reality in an abstract manner by the construction of theoretical models which resemble reality on a partial basis. This category overlaps the first because it can be used to develop methodology, techniques, and a conceptual framework for appraising actual situations.

The thoughtful administrator who is concerned with water pollution control or any other field of resource management or public policy may have mixed emotions when appraising the findings of abstract, theoretical research. He may fully support the desirability of such research, but find himself reviewing the results somewhat critically when assessing them in terms of what they mean and how they can be used in his program. This may be partially due to the fact that he does not understand the research, but it may also be due to the fact that the findings simply cannot be translated into the rules of the game -- the political process, and those laws and trends in public and Congressional attitudes which must guide the operations of his program.

This is not to argue against the construction of pollution control Utopias involving ideal organizations and rational systems of operation. Such concepts can be very useful not only theoretically, but also in practical ways. As one example of the way in which a theoretical approach could be helpful in guiding a program, a point from Mr. Kneese's paper will be cited. Mr. Kneese pointed out that critical events in stream pollution are infrequently occurring events as a result of variability in streamflow. He said that the possibility should be explored of coping with such problems by methods involving high operating costs which would be very expensive for a short period of time during drought periods, rather than by additional capital investment such as the construction of increased reservoir capacity for use only during extreme drought periods. Such short-term operating methods could involve, for example, the application of additional chemicals in sewage treatment plants.

In theory, this concept is a good one. However, if the many municipal and industrial waste treatment operators within a given river basin were to be relied upon to adjust their methods of treatment in accordance with streamflow conditions, critical problems could occur. Successful operation of such a program would require:

(a) A stronger program of training treatment plant operators.

(b) A better system of information and controls to assure that the operators carry out the means of treatment in the determined and required manner.

The concept of the "economics of the rare event" probably could not be implemented successfully until these corollary control measures were put into effect. Thus, consideration of this concept immediately suggests the kind of programming, embodying a system of training and controls, which a water pollution agency would have to initiate in order to effect the savings involved. Actually, none of these points have been unrecognized, but the analytical framework throws them into sharper focus for consideration by the administrator.

On the other hand, many theoretical analyses of water resource development seem to have little potential application. In many such studies, an edifice of perfect logic is created, but the logical structure is qualified extensively. We often find theoretical models which cannot be criticized on a logical basis, but which are hollow because all of the real problems have been excluded with the qualifications. Thus, we find conclusions advising us, in effect, that social choice as a basis for setting the objectives of the program cannot be subjected to the analysis but that, once the objectives have been determined, the resource manager should meet these by the cheapest alternative. Such conclusions, while correct, provide no new information which would be useful in administering the program, since it is standard practice to reach a given objective by the cheapest alternative.

The statement was made during the course of the symposium that a principal value of economic analysis was that it showed those responsible for pollution control that abatement can be regarded as a cost as well as a benefit and that, with varying costs of abatement, varying levels of benefits are achieved. This was cited as information which those concerned with pollution control programs are sometimes unaware of. Pollution control policies may not be extremely sophisticated; yet pollution control administrators have long recognized the basic fact that, with varying levels of investment in waste treatment facilities, varying benefits can be obtained.

A very clear example of this is the stream classification systems which have provided the basis for administering pollution control programs in various states. Such systems are based on the concept that the level of treatment required on any stream or given stretch of stream should be specifically determined in accordance with the beneficial uses of that stream. An interesting point is that this concept appears to be undergoing some change nationally.

Two years ago the National Conference on Water Pollution adopted the recommendation that the goal of pollution control should be keeping waters as clean as possible, as opposed to the policy of attempting to utilize the full capacity of the waters for waste assimilation. This recommendation was subsequently adopted by the President's Water Pollution Control Advisory Board. Mr. Towne, in his remarks, described how this approach is being put into practice in planning for water quality control in the Pacific Northwest. At first glance, this policy appears to be a movement away from the strictly analytical approach which would carefully delineate beneficial uses as a basis for the required level of treatment. The newer policy indicates that effluents should be returned in as clean a condition as possible, which, in effect, sets constraints amounting to the requirement of secondary treatment without specifically assessing beneficial uses for each body of water involved before arriving at this requirement. This policy is not an irrational one, but rather a practical recognition of reality. There seem to be several reasons for this changing philosophy. The difficulties in administering the more precise analytical approach are very great. The hypothetical example was given early in the symposium of a stream which was so polluted that it supported no uses other than waste disposal. The conclusion would be that waste treatment on this stream could not be afforded because beneficial uses would not justify it. This represents a simplified example of the type of approach which can lead to a descending spiral in water quality. The problem of reallocating assimilative capacity on a stream to accommodate a newly established industry is yet another example of the administrative difficulties encountered in this approach.

Other impediments to applying the more specific analytical method are based upon the lack of technical knowledge. If a sharply delineated classification is established for a stream, can we really be sure that the criteria used are meaningful? In many cases, we do not have sound criteria for water uses, particularly with respect to the vast array of new pollutants which are now being discharged into streams.

(Several speakers mentioned a related point: the need to correlate research in the physical and social sciences. Technical information must be available in order to develop sounder policies and social judgments; and conversely, socio-economic information must be available to guide technical decisions. For example, there would be little point in saying that water quality on a stream should be managed to provide benefits, both economic and intangible, to fisheries and other uses which would be at least equivalent to the cost of waste treatment if (a) the physical benefit to the fisheries from any given level of water quality improvement cannot be determined, and (b) the economic and social value of that benefit cannot be measured. The technical and social aspects are interrelated, and it is hoped that research will move forward simultaneously in both areas.)

To summarize this question of changing national policy and the apparent moving away from a strictly analytical approach towards a more generalized solution, one might conclude that there are both administrative and technical difficulties in carrying out what would appear to be a sound analytical approach. Further, the evidence seems clear that in some parts of the country where such an approach has been used as the basis for determining pollution control policies, this has not prevented a steady deterioration in water quality. Combined with this is an increasing intensity of water use nationally, with almost every available body of water coming into demand for recreation, fisheries, and other purposes. Perhaps, then, what the more generalized policy says is that all the streams in the Nation, as a general rule, will be in such demand for all beneficial uses that secondary treatment will be required and, therefore, classification is impractical, particularly when compared with the administrative and technical problems inherent in such an approach.

The above assessment is a personal and subjective view as to why this policy shift is occurring. It may be erroneous. However, this area appears to be a very fruitful one for research. The point is that a penetrating case study of the actual situation would appear to be more useful than the formulation of precise theoretical model, which we know that we are already moving away from on a national basis.

Roy Bessey pointed out in his address that a clearer understanding of the area of public policy formulation and determination of goals will be dependent upon research in a wide range of disciplines. It appears clear that we will have to look to areas of social science other than economics for answers here. (After all, the vast majority of people in the Nation have had no training in economics and sometimes refuse to behave in accordance with market theories.) Research in disciplines such as political science and social psychology should enable us to better understand public preferences and the way in which they are expressed; and the way in which objectives are determined and decisions are made in public programs. Research findings might provide means of improving this process through devising more efficient institutional arrangements and the like. We also need a better understanding of means of informing the public and creating public awareness so that sounder decisions can be made; both Mr. Haggard and Mr. Scheufele discussed this problem in their addresses.

During much of the symposium there was an emphasis on the regional nature of the problem. Water quality control must increasingly be considered on the basis of entire regions or river basins rather than on a point-by-point basis, and as an integral part of multiple-purpose water resource development programs. This creates a demand for regional organization to cope with the problem. Mr. Scheufele indicated in his pragmatic assessment that we have had many excellent studies of regional organization for water resource development, the findings of which are not being implemented, and that additional research to develop the ideal organization is not required. Instead, we might seek to understand why the existing knowledge is not being put into effect.

It is suggested that research on regional institutions should not be concerned with devising the ideal single regional agency because the creation of such an organization does not appear to be at all imminent. Instead, research might more fruitfully be concerned with means of achieving effectiveness on an inter-agency basis with the wide spectrum of organizations at all levels of government which are presently involved in water resource development.

Allen Kneese developed an approach based upon one regional entity which would be responsible for water pollution control. It would be interesting to extend Mr. Kneese's work to see whether his concepts could be implemented within the framework of multi-level regional organizations. In most parts of the country, based upon legislative and institutional constraints, pollution control programs must be carried out on an intergovernmental basis. Different entities are, in fact, responsible for dealing with different aspects of the total problem. The Federal Government builds and pays for reservoir storage, while local government, with federal and sometimes state financial assistance, constructs waste treatment plants. These two broad means of coping with the water quality problem, then, are not alternatives -- at least not in the sense of cost distribution. This point is set forth as national policy in the Federal Water Pollution Control Act, which states that storage in federal reservoirs shall not be provided as a substitute for adequate waste treatment facilities.

This question of cost distribution in water pollution control is certainly a major area for economic research. In fact, cost distribution has been one of the major issues in most studies of national water policies. We have developed historically a series of somewhat inconsistent national policies concerning this, and the need to better understand cost distribution as it affects water policy objectives applies to functions such as irrigation, navigation, and flood control, as well as to water quality control. Who should pay for a given water resource development program -- the local units of government, the private beneficiaries, the State, or the Nation as a whole?

For example, one of the speakers discussed the matter of whether industry should be given at least partial assistance to pay for the cost of industrial waste treatment. This matter points to the need for knowledge of how the costs of industrial waste treatment are actually borne. Is the cost of industrial waste treatment borne by the industry, is it passed on to the consumer in the cost of the product, or is it borne by the local unit of government involved? This will depend upon such factors as the competitive nature of the industry, the elasticity of demand for the product, the national and regional distribution of production, and the uniformity of pollution control requirements among the states involved. It would appear that studies of the economics of taxation, which have attempted to assess how taxes imposed upon industry are borne, could be applied to this aspect of water pollution control.

A major aspect of this symposium, and one which was emphasized not only in the specific paper presented by Mr. Price, but also in the program as a whole, was that of planning for water pollution control. With the rapid growth of population and changing technology, water pollution control is being more and more planning-oriented. Pollution control programs are now involved with many major future problems, as well as with immediate problems. This relates closely to the concept of water pollution as a regional issue. Today we are as much or more concerned with the development of regional plans for water quality control as with point-by-point methods of dealing with individual cases.

Many of the findings of socio-economic research could be applied to the solution of individual cases; yet, even more, we are concerned with such findings in order to be able to integrate them into the planning process. A better intellectual basis for planning and a better understanding of the planning process are required. A recent discussion of urban and regional planning indicates that the need for better planning procedure is by no means confined to water quality management: "In recent years systematic inquiry into the urban and regional planning process in action has been almost nonexistent. Planning literature does include, of course, useful articles by practicing planners and others on various techniques, methods, and problems, but nearly all of them draw largely on personal experience plus limited comparisons with a few other usually similar agencies." 1/

The use of the economic base forecast as a tool in planning was described by Mr. Katz. A lively discussion followed the presentation of his paper. The question was asked as to how the economist takes into account potential major changes, such as changes in foreign relations, technology, and the like when forecasting the future. The answer was given that, when the economist forecasts the future, he does not do so with a great deal of confidence. A major question for planning procedure, particularly in dealing with resource decisions which are irrevocable, is how much reliance, as a basis for decision-making, should be placed upon economic forecasts derived from a study of known resources and presently foreseeable technology and needs.

Mr. Dworsky made a suggestion that the potentialities of the resource might be one basis for gauging the level of the development program to be carried on, with the economic forecast being used as a general index upon which to base scheduling. He made reference to preliminary thought being given to this approach in the Water Supply and Pollution Control Program. 2/

The study of the proposed Rampart Dam project in Alaska, where a tremendous potential for low-cost hydroelectric development exists, appears to be an example of this approach. This project was not studied by forecasting the future of Alaska and its power loads, and then seeking a means of meeting these. Instead, the great potential of the resource as a means of stimulating development in Alaska was recognized; then an economic study was made to see whether this resource potential, if developed, could be utilized. In resource planning in more developed areas, decisions may involve a much more complex balancing of resource potentials versus forecasts of requirements. In any case, it seems clear that there is a need to think about and possibly modify the planning process with respect to the use of forecasts where resource decisions are irrevocable or where an extremely long lead time is involved.

1/ Coleman Woodbury, Land Economics Research for Urban and Regional Planning, in Land Economics Research, Farm Foundation, Resources for the Future, 1962, pp. 63-88.

2/ A Proposed Method of River Basin Analysis for Water Pollution Control with Special Reference to Low Flow Augmentation, Water Supply and Pollution Control Program, Pacific Northwest, Public Health Service, September 1961.

Water quality is frequently a determinant of land use and, as in the case of economic forecasts, land use is a component of the water quality planning process requiring additional attention. Land use plans must be related to plans for water quality control; for example, if the intent of the water plan is to provide water for recreation in a metropolitan area and the metropolitan planning agency's land use plan provides for an industrial area in the stretch of river involved, the required coordination is obviously lacking. Conversely, the effects of land use as a pollutant must be incorporated into the water quality planning process. Mr. Bullard's address delineated land use as a pollutant, which is just now being recognized as amenable to improvement. How can this aspect of land use be related to water quality planning to develop plans which will minimize the effects of pollution?

The Public Health Service, Division of Water Supply and Pollution Control, has developed a statement of general guidelines for use in formulating a program of social and economic research on water quality control. This is as follows:

> A program of research in socio-economic aspects of water quality management should have the following objectives:
>
> 1. The development of basic ideas for the economic evaluation of matters concerning water quality;
>
> 2. The identification of data inadequacies and a program for overcoming these inadequacies or the devising of a simulated data method involving economic and social factors related to water quality;
>
> 3. The development of methodology for forecasting water use, changes in water use practices, and related matters having implications for water quality and its control;
>
> 4. The determination of the nature and extent of the contribution of water resources development to national and regional economic growth, with specific reference to water quality management;
>
> 5. The determination of the effect of various water quality changes on land use and the effect of land use on water quality; and the determination of the extent that water and sewage systems can be used to control urban development and land use;

6. The identification and analysis of the effects of various aspects of the decision-making processes in water quality management, including the laws, arrangements, values, and attitudes involved.

Although it is known that the economic value of water is associated with its usefulness as related to the supply and demand, and that the world of water may impair or enhance usefulness, no way exists at present to determine the economic demand curve of water for various uses; nor has the related concept of "willingness to pay" been established, even within some reasonable range.

A rigorous examination of both the demand curve and willingness-to-pay situation is necessary to establish the value of water in the various uses. From this point, impairment of use can be calculated as an economic damage in dollar and other economic terms. Analytical concepts are necessary to achieve this objective.

The problem of economic analysis derives as much from inadequate data as it does from conceptual frailties. A rigorous determination should be made as to what specific data are needed to facilitate analysis; and a course of action to obtain the data should be prescribed. This phase of the research effort will require the cooperation of persons knowledgeable in water-use practices of all kinds: cooperation of econometricians, as well as economists in the data analyses. In those instances where data inadequacies cannot be overcome, perhaps some method of establishing assumed or synthetic data could be devised for analysis.

At present, the methods for forecasting water use are almost capricious, for they lack an adequate rationale. In part, this situation is due to inadequate knowledge of the factors that influence water use, and in part it is due to data lack. To a small extent, the problem will be reduced if methodology is improved in regional economics. That is, as the methods for determining the level and kinds of economic activity in geographical parts of the nation are improved, then the types and sizes of various water-using industries would be more rationally established. Again, persons familiar with various water-use practices must be available to economists and other social scientists to assist in establishing the factors which indicate water use.

In conjunction with these efforts, knowledge should be developed as to the contribution of water resource development to the level of economic activity, both on a national and regional basis. This knowledge should establish the extent to which deliberate investment in water-resource development, with particular reference to water supply and quality control, could be used to aid industry's general economic growth, or to produce particular kinds of growth.

Although it is self-evident that land and water uses are interrelated, no firm record exists as to the effects of water quality changes on land use, nor of land use changes on water quality. Also, study is needed of the extent to which water quality control can be used to induce or complement desired land uses, and the extent to which water and sewage systems can be used as devices to control urban development and facilitate quality objectives.

To contribute to the understanding of the entire problem, analysis should be undertaken into the setting in which decisions are made affecting water-resource use and development. This effort should scrutinize the institutions of government that are directly involved; the framework of law and regulation involving property rights, zoning, and other forms of social control; the attitudes and beliefs of various publics affecting use, and analysis of the myths that prevail in this realm, such as the abundance or scarcity of water, renewability, quality detractions, and the inherent attraction of water as a locational determinant.

It is to be hoped that the socio-economic research needs delineated in the above statement, and by the participants in this symposium, will receive increased attention in the future.

ATTENDANCE AT THE ELEVENTH SYMPOSIUM

November 8 and 9, 1962

Thomas C. Adams	PNW Forest & Range Expt. Sta.	Portland
R. M. Alexander	Oregon State University	Corvallis
E. J. Allen	Seattle Water Department	Seattle
H. Kenneth Anderson	Portland Bureau of Water Works	Portland
Earl R. Anthony	U. S. Geological Survey	Portland
John G. Bailey	Oregon State Board of Health	Portland
Wesley C. Ballaine	University of Oregon	Eugene
A. F. Bartsch	U. S. Public Health Service	Portland
Walter O. Basham	Corps of Engineers	Portland
Paul C. Benedict	U. S. Geological Survey	Menlo Park
Roy F. Bessey	Consultant	Portland
Nedavia Bethlahmy	PNW Forest & Range Expt. Sta.	Portland
D. E. Bevan	University of Washington	Seattle
A. R. Blanch	U. S. Public Health Service	San Francisco
R. O. Blosser	Oregon State University	Corvallis
Robert L. Boster	Portland State College	Portland
A. R. Bryant	U. S. Public Health Service Lab	Portland
W. E. Bullard	U. S. Public Health Service	Portland
F. J. Burgess	Oregon State University	Corvallis
Melvin H. Burke	U. S. Forest Service	Portland
Daniel Burroughs	National Park Service	Portland
Homer J. Campbell	Oregon State University	Corvallis
Dale A. Carlson	University of Washington	Seattle
Glen Carter	Ore. State Sanitary Authority	Portland
Kenneth T. Case	Corps of Engineers	Portland
E. N. Castle	Oregon State University	Corvallis
George G. Chadwick	Oregon State University	Corvallis
Donald W. Chapman	Oregon State University	Corvallis
J. F. Cormack	Crown Zellerbach Corp.	Camas
John Courchene	Seattle Water Department	Seattle
James A. Crutchfield	University of Washington	Seattle
W. F. Cyrus	Crown Zellerbach Corp.	Camas
John H. Davidson	U. S. Public Health Service	Portland
Delmer S. Davis	Bureau of Sport Fisheries	Portland
Paul DeFalco, Jr.	U. S. Public Health Service	New York
George R. Dempster	3028 N. E. 70th Ave.	Portland
Byron L. Doneen	Soil Conservation Service	Portland
Peter Doudoroff	Oregon State University	Corvallis
Robert Drager	Ore. State Planning & Development Dept.	Portland
Donald P. Dubois	U. S. Public Health Service	Portland
E. G. Dunford	U. S. Forest Service	Portland

Gilbert Dunston	Washington State University	Pullman
Leonard B. Dworsky	U. S. Public Health Service	Washington, D. C.
E. F. Eldridge	U. S. Public Health Service	Portland
W. E. Eldridge	U. S. Public Health Service	Portland
Warren W. Etcheson	University of Washington	Seattle
Curtiss M. Everts	Ore. State Sanitary Authority	Portland
James W. Ferguson	Portland State College	Portland
Theodore Ferris	U. S. Public Health Service	Portland
Garry L. Fisk	U. S. Public Health Service	Denver
Donald F. Flora	PNW Forest & Range Expt. Sta.	Portland
Louis H. Foote	State Water Resources Board	Salem
Richard J. Frankel	University of California	Berkeley
Mrs. Rowena M. Funston	Corps of Engineers	Portland
D. R. Gedney	PNW Forest & Range Expt. Sta.	Portland
Charles V. Gibbs	Municipality of Metropolitan Seattle	Seattle
P. A. Glancy	U. S. Geological Survey	Portland
John R. Glassy	City Water Department	Tacoma
J. Wendell Gray	Public Health Service, Ore. State University	Corvallis
Mrs. W. D. Hagenstein	Ore. State Water Resources Bd.	Salem
Marko B. Haggard	Portland State College	Portland
W. N. Hale	Ore. State Bureau of Mines	Albany
Sigurd Halvorson	Corps of Engineers	Portland
Horace W. Harding	U. S. Dept. of Labor	Seattle
William L. Haushild	U. S. Geological Survey	Portland
I. B. Hazeltine	Bureau of Sport Fisheries	Portland
Allan Hirsch	U. S. Public Health Service	Portland
Dale Hoffman	U. S. Public Health Service	Portland
Gilbert A. Holland	Wash. Dept. of Fisheries	Seattle
D. H. Huff	Department of Interior	Portland
Arthur J. Inerfield	Calif. Dept. of Water Resources	Sacramento
Ralph H. Imler	Bureau of Sport Fisheries	Portland
Theodore Jaffe	Robert A. Taft Sanitary Engineering Center	Cincinnati
Reinhard Jaren	Rt. #1, Box 563	Oregon City
Brian Johnson	Washington Pollution Control Commission	Olympia
Clyde Johnson	Portland State College	Portland
Donald N. Johnson	University of Oregon	Eugene
Max Katz	University of Washington	Seattle
Myron Katz	Bonneville Power Administration	Portland
Robert E. Keith	Metropolitan Planning Comm.	Portland
Allen V. Kneese	Resources for the Future	Washington, D. C.
L. B. Laird	U. S. Geological Survey	Portland
Donel J. Lane	Ore. State Water Resources Bd.	Salem
Ralph Larson	Washington Dept. of Game	Olympia
Charles F. Lemon	Soil Conservation Service	Portland

James A. Macnab	Portland State College	Portland
R. J. Madison	U. S. Geological Survey	Portland
Nick J. Malueg	U. S. Public Health Service Lab	Portland
James E. Maxwell	Bonneville Power Administration	Portland
Tom McCall	KGW-TV	Portland
James C. McCarty	U. S. Public Health Service	San Francisco
Charles McKinley	Portland State College	Portland
Robert O. McMahon	PNW Forest & Range Expt. Sta.	Portland
Harold E. Miller	Municipality of Metropolitan	Seattle
Harold E. Milliken	Ore. State Board of Health	Portland
Robert Minnehan	U. S. Public Health Service	San Francisco
W. Allan Moore	U. S. Public Health Service Lab	Portland
Wm. B. Morse	Wildlife Management Institute	Portland
Edwin Nasburg	Bureau of Reclamation	Portland
Alfred T. Neale	Washington Pollution Control Commission	Olympia
F. L. Nelson	U. S. Public Health Service	Olympia
Lyman A. Nielson	Washington Pollution Control Commission	Olympia
K. C. Nobe	U. S. Public Health Service	Denver
R. T. Oglesby	University of Washington	Seattle
James A. Ogren	U. S. Public Health Service Lab	Portland
Karl W. Onthank	Ore. State Water Resources Bd.	Eugene
Mrs. Karl W. Onthank	League of Women Voters	Eugene
Charles R. Ott	Washington Pollution Control Commission	Olympia
Herbert R. Pahren	U. S. Public Health Service	Denver
T. E. Perry	U. S. Fish & Wildlife	Portland
D. C. Phillips	Oregon State University	Corvallis
R. F. Poston	U. S. Public Health Service	Portland
Reginal Price	Calif. Dept. of Water Resources	Sacramento
Ed. L. Quan	Oregon State Board of Health	Portland
Mrs. Roberta Remak	Ore. State Dept. of Planning & Development	Portland
Jack D. Remington	Pacific Power & Light	Portland
Edwin F. Roby	Bureau of Sport Fisheries	Portland
Donald Ross	Public Health Service	Olympia
Joseph F. Rudys	Civil Engineer	Applegate
John F. Santos	U. S. Geological Survey	Portland
Roy W. Scheufele	Corps of Engineers	Portland
Gilbert V. Schirk	Bureau of Reclamation	Boise
Ralph Scott	U. S. Public Health Service	Portland
R. W. Seabloom	University of Washington	Seattle
Eugene Snyder	U. S. Public Health Service	Portland
Carl E. Spencer	U. S. Public Health Service Lab	Portland
Kenneth H. Spies	Ore. State Sanitary Authority	Portland
Herbert H. Stevens	P. O. Box 3202	Portland

R. O. Sylvester	University of Washington	Seattle
James N. Tattersall	University of Oregon	Eugene
E. Roy Tinney	Washington State University	Pullman
W. W. Towne	U. S. Public Health Service	Portland
E. Jack Weathersbee	Oregon State Board of Health	Portland
Stanley E. Weber	Department of the Interior	Portland
R. C. Williams	U. S. Geological Survey	Portland
John N. Wilson	U. S. Public Health Service	Portland
William O. Winkler	U. S. Public Health Service Lab	Portland